The Economics of Childcare

by

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A thesis submitted in partial fulfillment of the requirements for the degree

of Doctor of Philosophy in Economics

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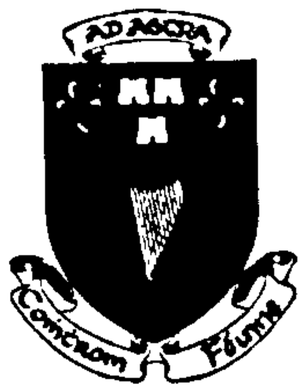

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Dublin, 18th May 2004

To Whom It May Concern:

By this letter I want to certify that I participated to the redaction of Chapter II, "THE SUPPLY OF CHILDCARE IN BRITAIN: DO MOTHERS QUEUE FOR CHILDCARE?" of Tarja Viitanen's PhD Thesis, but that Tarja is the main author of this paper that forms an integral part of her thesis. Please feel free to contact me for further queries concerning this matter.

Sincerely,

Arnaud Chevalier

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ABSTRACT

This thesis examines aspects of the market for childcare that affect female labour force participation and the use of childcare. The literature review indicates that previous research on the topic has not come to any clear conclusion on the impact of the price of childcare on the labour force participation and the use of childcare of mothers of pre-school age children.

I examine the market for childcare in the UK in particular. In the UK, the common complaints made about childcare include the lack of availability and its high price. I study these two topics separately in Chapter 2 and Chapter 3 respectively. The lack of childcare availability is confirmed in Chapter 2 with its finding that there is a large excess demand for childcare in the UK.

A topic intertwined with the availability of childcare is the impact of the price of childcare. I estimate the price elasticities with respect to labour force participation and the use of formal childcare in Chapter 3. I find that a lower price for formal childcare would have a significant effect on the labour force participation and the use of childcare of mothers of pre-school age children.

The results in Chapter 2 and Chapter 3 may indicate that the market for childcare has failed in the UK. The unsatisfied demand for childcare and the high price for formal childcare that is available are likely to result from a lack of providers in the formal childcare market. Hence it may be necessary to examine whether a subsidy for the producers of childcare can increase the provision of formal childcare and decrease its price to bring the childcare market to an equilibrium.

In Chapter 4, I examine whether the methods of childcare financing used in Finland could provide solutions to dealing with the UK childcare problem. In particular I examine the impact of a voucher for privately produced childcare that was adopted in Finland in an experimental setting. I find that, in a market with widely available, low cost public care, the voucher for privately produced childcare has a significant effect on the labour force participation and the use of childcare working through increased availability of private childcare and its lower price.

INTRODUCTION: THE ECONOMICS OF CHILDCARE

> "Childcare has been neglected for too long. [...] the quality of care can be variable, there are not enough childcare places, and ordinary working parents often cannot afford to take them up."
>
> *Green Paper DfEE (1998)*

Britain's Prime Minister Tony Blair's foreword to the Green Paper for the launch of the National Childcare Strategy identifies three areas of concern in the market for childcare in the UK - accessibility, affordability, and quality. The National Childcare Strategy, launched in May 1998 by the Secretary of State for Education and Employment, promises to raise the quality of formal childcare[1], to make it more affordable, as well as to increase its provision (DfEE, 2001).

The government promises should be welcome to the general public. The Independent (2.9.2001) reports that the "British childcare is worst in Europe". This claim is based on a study by the Daycare Trust that finds that the childcare provision in Britain comes close to the bottom among the 15 European Union member states using measures such as publicly funded nurseries and parental leave (Moss, 2001). The director of the Daycare Trust, Stephen Burke concludes that "compared to many of our European neighbours, where childcare is a key

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[1] From hereafter references to childcare in this thesis refer to formal childcare unless stated otherwise. Formal childcare includes the following types of care: nursery schools/classes, childminders, crèches and playgroups (see Appendix 1 for detailed description of these different types of childcare). Furthermore, this thesis examines only pre-school childcare (the official school starting age in the UK is five).

part of economic and social structure that families take for granted, the UK still has a long way to go".

Instead of heavy public investment in childcare witnessed in many of our European neighbours, Britain has relied on the markets to provide the childcare to the majority of its inhabitants. Public support is offered mainly for low-income and single-parent families. The support is monetary in nature with little investment in the childcare infrastructure. In theory markets should be able to deal with the demand for childcare by parents of young children. However, there may be reasons to argue that the childcare market in Britain fails and is not able to supply enough childcare places for a price that parents are willing or able to pay.

The main objectives of childcare are to help parents gain employment while their children are young and enhance the educational and psychological development of children[2]. In a large survey by La Valle et al. (2000), two-thirds of non-working mothers in the UK would prefer to work or study if they had access to good quality, convenient, reliable and affordable childcare. Thirty-one per cent of parents who used some form of childcare in the previous year admitted that there were times when they would have needed more childcare hours but were unable to obtain them. This proportion is larger for lone parents and those in the lowest income groups (La Valle et al., 2000). Nearly ¾ of working parents said their childcare arrangements are not ideal, with most common reason being

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[2] Throughout the thesis the terms employment and labour force participation are treated synonymously and refer to non-employment versus employment at any level of hours.

lack of local provision and inability to afford more adequate care (La Valle et al., 2000)[3]. The Daycare Trust reports that 43% of parents want, as top priority, more affordable provision of childcare, 38% want increased availability of care; furthermore, ¾ of parents say that working mothers cannot find enough affordable childcare[4].

Parents as consumers of childcare are facing conflicting sets of needs: those of their offspring regarding the quality of care and their own needs for convenience, affordability and reliability. Providers of childcare are better informed about the quality of the care they provide than the consumers of formal childcare. The information is therefore asymmetric, and the resulting unfair exchange is often an inefficient allocation of resources, or market failure (Akerlof, 1970). Mocan (2001) in a unique paper in the childcare literature demonstrates the existence of information asymmetry and adverse selection in the childcare market as well as provides some limited evidence for moral hazard. Therefore, since market competition does not seem to create childcare services of acceptable quality suitable to every family budget, government intervention may be desirable in order to increase total social welfare.

Different aspects of the childcare market that may be associated with market failure include the quality of childcare, accessibility to childcare and its price. A 2001 MORI survey commissioned by the Daycare Trust found that 70% of all

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[3] The findings are based on a Baseline Survey of Parents' Demand for Childcare for children aged 14 and under in England and Wales.
[4] MORI surveys published by the Daycare Trust on 22.5.2000 and 30.04.2001.

surveyed parents said that the availability of well-trained experienced staff is the most important factor in high quality childcare provision (Childcare Trust, 2001a). Less than a quarter of UK parents use formal childcare on a regular basis[5], of whom 90% was happy with the quality of childcare (La Valle et al., 2000). Hence for the remaining non-users of childcare the perceived quality of the childcare available may be a deterrent to use formal modes of childcare. The literature review on Chapter 1 reviews the previous literature on the quality of childcare.

Discussions on the accessibility to childcare focus on the parents' ability to find appropriate childcare for their offspring. The problem is one of providing access to decent and affordable childcare to the pre-school age children in the UK. Holloway and Tamplin (2001) report that the total number of UK childcare places has increased by approximately 13% between 1995 and 1999 despite of a fall in the under 5 population. However, the number of childminder places, which may be the preferred choice of care for many parents because of the flexibility in hours and often a more convenient location, has actually declined in the more recent years. Ideally the childcare available to parents is conveniently located: 49% of surveyed parents expressed the location being their top priority when choosing a childcare provider. Many have argued that there is a shortage of childcare options available to parents. A MORI survey commissioned by the Daycare Trust finds that 75% of parents of young children say that there is not

[5] Author's calculation from the Family Resources Survey 1994-1998.

enough childcare provision (Daycare Trust, 2001b). Advocates of this position also point to long waiting lists for formal childcare. The government estimates that there are only 830,000 registered childcare places for the 5.1 million under 8-year-old children in England, which gives a ratio of approximately one place to every six children[6]. This potential shortage of childcare providers is likely to worsen with time as the participation of women to the labour market is due to increase by 1.5 million individuals between 1999 and 2010 (Wilson and Green, 2001). Chapter 2 examines this issue of accessibility in the UK childcare market.

A substantial part of the household disposable income is devoted to childcare expenses. According to the Daycare Trust "the typical cost of a nursery place [is] more than the average household spends a year on either housing or food". For a family with a pre-school age child living in London and where mother works and purchases childcare, up to a fifth of family income is devoted to childcare. As a result, concerns about the affordability of childcare are often focused on families in the lower end of the income distribution. Hence the UK government has introduced policies, such as the childcare element of the Working Tax Credit, to reduce the costs of childcare to parents of young children and hence enable employment. Chapter 3 examines the issue of affordability in the UK childcare market.

The accessibility, quality, and affordability are related to the price of childcare. The problem of affordability comes from the large proportion of

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[6] Unfortunately this information is not provided separately for pre-school age children.

family income being spent on childcare. Accessibility is a problem possibly because of the supply, or rather the lack of supply, or because families are unwilling to or unable to pay the market price for the level of quality of childcare they prefer.

The price of childcare provides an important policy instrument with impacts on family disposable income, the quality of childcare and the accessibility to childcare. Furthermore, there exists possible macroeconomic impacts in the form of increased labour force participation and hence increased government tax revenue.

My thesis is organised as follows: Chapter 1 provides a literature review on the different aspects of examining the childcare problem. Chapter 2 estimates the queue for formal childcare, while Chapter 3 examines the impact of price of childcare on its use and the labour force participation of mothers in England. Chapter 4 examines one possible solution to the UK childcare problem - the use of vouchers that was the chosen policy instrument in Finland - to increase the efficiency of childcare markets.

In Chapter 2, I examine the extent of excess demand for childcare in England in a paper co-authored with Arnaud Chevalier. Numerous reports mentioned earlier have indicated that parents of young children would like the availability of childcare to increase. However, no formal analysis has examined whether the childcare market is in a disequilibrium. The main difficulty in measuring the

excess demand for childcare results from the lack of data, which includes both the supply and the demand information of the UK childcare markets. Our method used in the analysis is unique to the childcare literature and the results indicate large excess demand for childcare, which is not filled by the childcare supply in the UK.

Chapter 2 presents a model of partial observability applied to the childcare market in England. We simultaneously estimate the demand for childcare and the use of childcare and calculate the excess demand for childcare. The size of the queue for childcare is substantial: while a bit more than 70% of mothers would like to use childcare, only 57% are provided with a place for their child. Furthermore, it appears that a majority of mothers queuing for childcare are using informal care as a substitute, thus a policy increasing the supply of formal care may not have a large impact on the labour force participation of women, but mostly shift children from informal care to formal care.

In Chapter 3, I estimate the price responsiveness of mothers of pre-school children to formal childcare use and their labour force participation. The estimation results in Chapter 3 reveal that demand for childcare is relatively inelastic. The estimation method simultaneously accounts for non-random selection into use of formal childcare and employment using a double-selection model. This corrects for the fact that childcare expenditure is only observed for those individuals who use childcare and that the wages are only observed for employed individuals. Furthermore, the method takes into account the positive

correlation between the use of childcare and the probability of labour force participation.

The estimated price elasticity of demand for childcare with respect to employment is –0.17 and with respect to the use of formal childcare is –0.09. These results allow the estimation of a simulation study to examine the extent to which childcare subsidies can affect the work behaviour of these mothers. The simulation results show that, if there were a universal zero-cost childcare available to the mothers in this sample, the model predicts that 76.1% would be employed while only 44.8% would be using formal childcare assuming that the supply of childcare is perfectly elastic[7]. Almost a third of the mothers are hence predicted to use informal care when they work even if childcare was provided free of charge. This has very important public policy implications. For example, if large government subsidies are given to childcare that lower the net costs of childcare to families, then more women are likely to enter the labour force. This would result in higher government expenditure, which would partly be offset in the form of increased tax revenue.

The policy-relevance of the topic in Chapter 3 is closely related to recent government initiatives regarding in-work subsidies. The Working Tax Credit (WTC) includes a childcare element, which helps low-income, working

[7] The actual figures for labour force participation and the use of childcare are 50.5% and 27.4% respectively and the baseline simulation figures are 50.7% and 28.1% respectively.

households with the costs of registered or approved childcare[8]. However, the decision to become employed depends on the characteristics of the individual such as their wage rate as well as the price of childcare. Therefore, the childcare element of the WTC may or may not have the effect desired by the policy makers. This claim is supported by a finding by Kasparova et al. (2003), who find that a disproportionate share of subsidised childcare benefits the financially better off households. This is mainly due to the fact that households living on lower incomes are more likely to rely on informal childcare provision, which is not eligible for a subsidy.

A possible answer for the UK childcare problem is to examine how other countries have dealt with their childcare issues. Chapter 4 examines in closer detail the childcare market in Finland.

Finland has invested in a large public provision of childcare since the early 1970's. In the mid 1990's, Finland spent approximately 1% of the GDP on childcare[9]. This compares to a spending of about 0.01% of GDP for the UK (Rake, 2000)[10]. Virtually no complaints are voiced in Finland regarding the price,

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[8] Working Tax Credit (WTC) tops up the pay of low paid workers. It is made up of a basic element, plus extra amounts depending on age, hours worked, amount of other income and disability status. Anyone with responsibility for children who qualifies for Working Tax Credit will also qualify for the Child Tax Credit. Child Tax Credit (and the childcare element of WTC) is paid directly by the Inland Revenue to the person who is mainly responsible for looking after the children, not through the pay cheque. Until April 2003, this childcare element was a part of the Working Families Tax Credit (WFTC) but has since been subsumed into the Working Tax Credit (WTC).

[9] Approximately 1% of the Finnish GDP in the mid 1990's was spent on childcare alone with the fees paid by the consumers covering only about 15% of the total cost.

[10] In 1999, the OECD countries spent an average of 0.7% of GDP on formal childcare (Jaumotte, 2003).

the availability or the quality of the public childcare. However, the high government expenditure on childcare has faced cut-backs in the early to mid 90's political environment and measures have been taken to reduce the expenditure and increase the efficiency of childcare markets.

Increasingly the public provision of childcare is being complemented with private providers to increase the efficiency of the markets. In the mid 1990's, Finland experimented with a move of public intervention from the supply side of the childcare market financing to demand side vouchers. Supply subsidies are funds distributed directly to the providers of the childcare services. These help keep down the costs of childcare centres to the family. Demand subsidies are funds distributed to consumers, either directly through the use of vouchers or cash grants or indirectly through the tax system. The Finnish experiment is a mixture of supply and demand subsidies; the families choose the childcare provider and the state then reimburses the facility directly. The research conducted in Chapter 4 uses a large-scale experiment to estimate the effect of vouchers for childcare on the mothers' labour force participation and the use of childcare in Finland.

Since the voucher for private childcare was implemented in only parts of the country, it allows the use of common methodologies used in empirical research for examining experimental set-ups. In my analysis, I apply both the difference-in-differences (DD) approach and the matching method. The DD method compares the difference in average behaviour before and after the reform for the group receiving the private childcare voucher with the before and after contrast

for the control group who did not participate in the experiment. Since the Finnish childcare voucher experiment was not randomised at the municipality level, I also estimate the impact of the voucher using the matching method. The non-randomisation at the municipality level may be a cause for concern if, on average, the characteristics of individuals or the municipalities themselves differ significantly between the treatment and the control region. Matching is based on selecting observable characteristics of individuals, who exhibit no systematic difference in their reaction to the policy reform. Therefore matching individuals in the experiment region to the individuals in the control regions based on these observable characteristics allows the calculation of the impact of the reform.

The two different methodologies adopted yield very different results. In general, the difference-in-differences results give insignificant impact of the voucher experiment on both labour force participation and the use of childcare. However, the crucial assumptions underlying the estimation fail in many cases. Therefore, the matching estimation may be a better strategy to estimate the impact of the experiment on behavioural outcomes of interest.

Chapter 4 concludes that in a market that is already providing high-quality, low-cost public childcare, a voucher for private childcare has a significant, positive effect on the use of formal childcare, especially in areas that suffer from excess demand for childcare places. The use of formal childcare increased by between 3 and 6 percentage points in the whole country while in areas of excess demand the increase was approximately 14 percentage points. Labour force

participation of mothers of older pre-school age children increased by over 5 percentage points in areas of excess demand.

Three voucher types were tested during the experiment and the results are provided for a voucher that requires the parents to work or study, a lump-sum voucher, and a means-tested voucher. These results are mixed and as the sample size gets smaller, better data would help clarify them.

None of the estimates of the private childcare voucher experiment examined in Chapter 4 are found to be significant for the mothers of 0-2 year old children. This may be due to the differences in the budget constraint of parents of the younger pre-school age children than those of older pre-school age children or differences in their preferences.

In the concluding chapter, I summarise my findings and attempt to shed light on the various issues regarding the availability of childcare and the impact of its price on the use of childcare and the labour force participation of mothers of young children. This collection of papers examines two very different types of childcare systems- UK with its mix of private and public provision and Finland with a large public childcare sector. While the UK experience may be overshadowed by the problems of excess demand and low quality, the Finnish experience prior to the private childcare voucher experiment suffers from high costs of the public provision to the taxpayers and inefficiencies in the allocation of childcare slots. Local municipalities should ideally be able to adjust the supply

of childcare slots to the needs of working parents while maintaining a high level of quality of childcare and its flexibility to the consumers. As discussed in the concluding chapter, a quasi-market, or a mixture of public and private provision, as experimented with in Finland may provide a partial solution to many of the problems faced in current UK childcare markets.

CHAPTER ONE: PREVIOUS CHILDCARE LITERATURE

1.1 Introduction

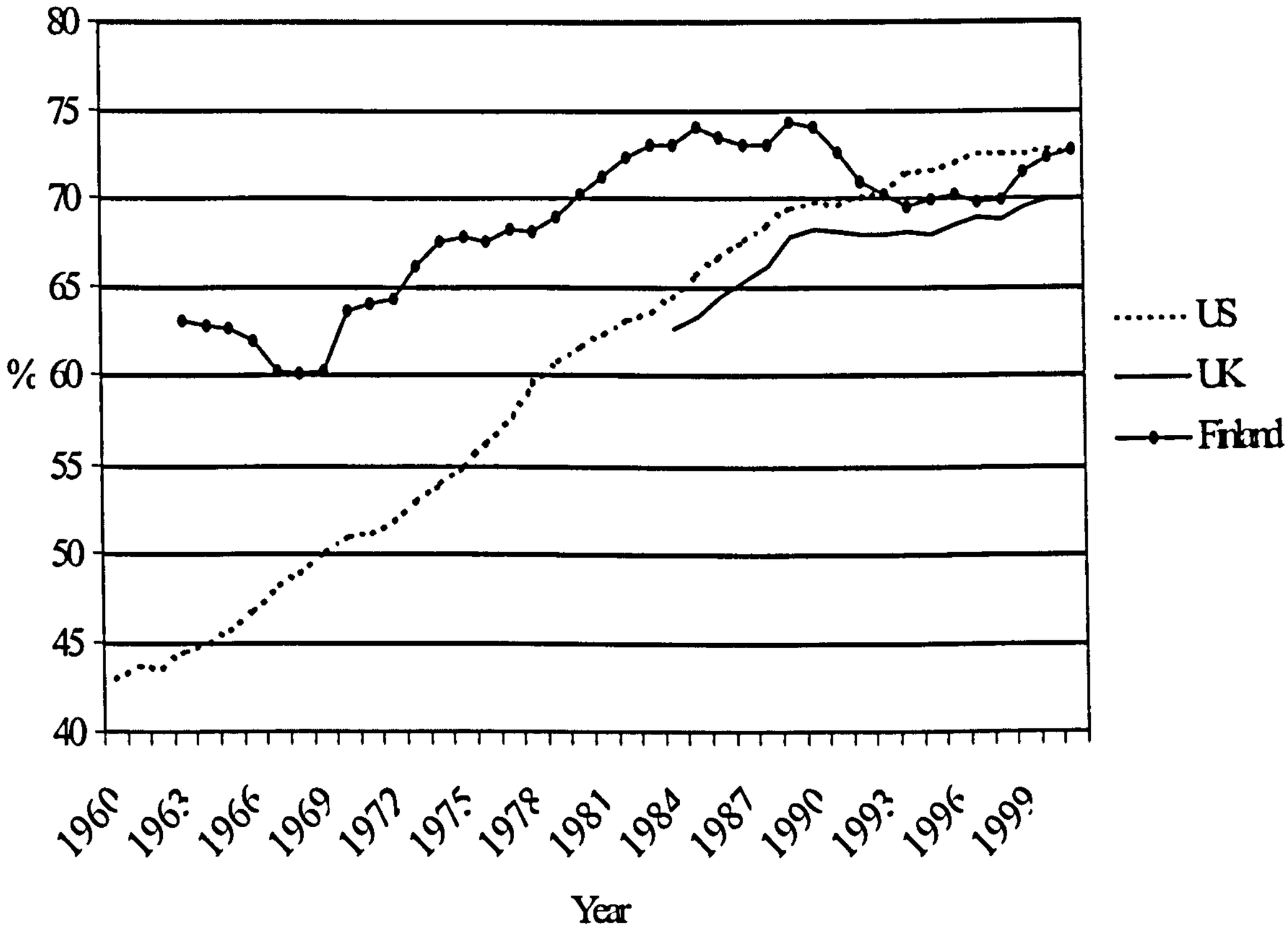
Labour economists usually emphasise that young children impose high time costs increasing the opportunity cost of working for the main caretaker of the children, usually the mother. This in turn raises the reservation wage of the mother. The increase in the reservation wages is at least partly due to the childcare costs that would be incurred if the women had participated in the labour force, hence lowering the participation probability.

The labour force participation of women varies considerably between countries. It can be noticed that often countries with large public provision of childcare have a high proportion of women in the labour force (for other determinants of female labour force participation see, for example, Jaumotte, 2003). A good example of this pattern is provided by the Nordic countries. On the other hand, countries that rely less on public subsidies for childcare have in general lower female labour force participation rates.

Graph 1.1 shows past labour force participation rates for the UK, US and Finland. All countries exhibit remarkable growth in the participation rates until the early 1990's. The early 1990's economic slowdown decreased the rate of growth in the UK and the US. The combined effect of the economic recession and the collapse of the Soviet Union decreased the level of female employment

by approximately five percentage points in the early 1990's in Finland (Vartiainen, 1998).

Graph 1.1: Labour force participation rates for selected countries



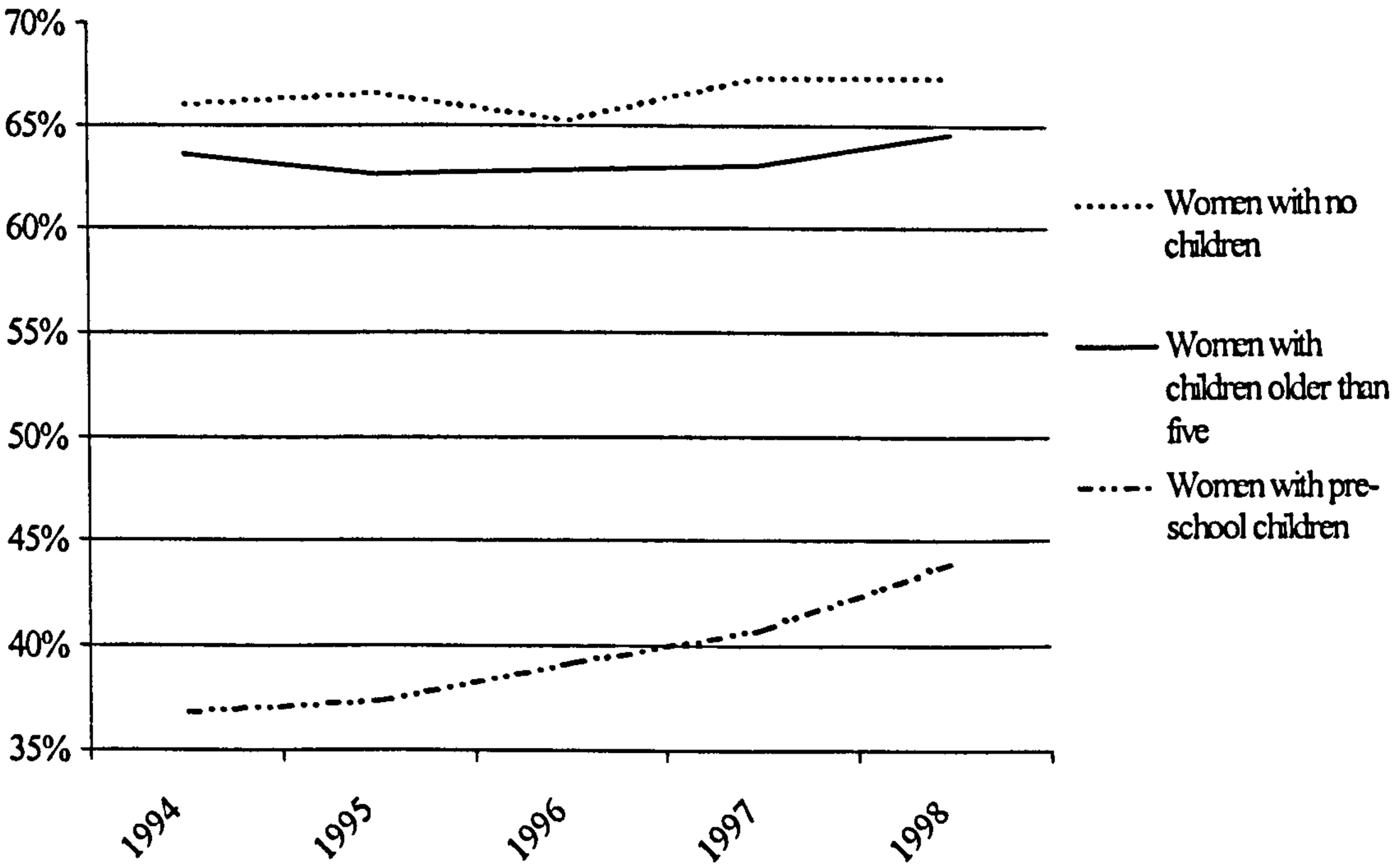
Source: OECD

There are a variety of factors that are responsible for the increases in female labour force participation over the past 30 years. Rising wage rates, due to increased investment in human capital as well as technological advances, have facilitated female entry into the labour force. Also, other reasons include the widespread use of the contraceptive pill (and hence reduced fertility), the rising

divorce rates, and the tremendous growth in the service sector jobs relative to the goods sector as well as a lower degree of product market regulation.

The growth in the childcare industry has corresponded to the rise in the female labour force participation rate. However, in countries where the childcare system is left to be developed on the market, for example, the UK and the US (see, for example, Blau, 2001 or Jaumotte, 2003), there seems to be excess demand for childcare services which is widely reported in the media.

Graph 1.2: Labour force participation in UK according to the level of fertility



The large difference in the labour force participation rates of mothers of young children and other women in the UK is depicted in Graph 1.2. This difference can be due to a choice made by the mothers of young children or to a

constraint posed by the presence of young children. Survey evidence quoted in the introductory chapter to this thesis indicates that a major explanatory factor may be the constraint that the presence of children poses for women's work decisions. A substantial proportion of British mothers feel constrained in their employment decisions because of the need to care for their pre-school age children: ¼ of non-working mothers would like a regular paid employment but are prevented from working by having to look after their children; 18% of mothers of pre-school age children who work part-time say they would like to work longer hours but are prevented from doing it due to child rearing responsibilities; 11% of mothers of pre-school age children who work part-time say they would work more hours if suitable childcare were available. Mothers of younger pre-school age children are less likely than mothers of older pre-school age children to report that they feel constrained in their labour force participation decision or increased working hours (Paull and Taylor, 2002).

It is unclear whether the mothers' reported preferences regarding their working behaviour and complaints about the lack of appropriate childcare provision are a sign of a market failure in the childcare sector. A market failure occurs when the supply of a commodity or a service is not at a level that would be optimal from the society's point of view. The difficulty of saying what is the socially optimal amount of childcare provision prevents us from concluding whether the childcare market fails in any fundamental aspect. In any case the

governments in the US and the UK have decided not to directly intervene in the childcare market.

Understanding the direct and indirect effects of children on labour supply is critical to a number of policy debates. Browning (1992) provides a comprehensive literature review on the effects of children on household economic behaviour. His conclusions include the finding that younger children are associated with lower labour supply by the mother. Furthermore, Voicu and Buddelmeyer (2003) find that the indirect effect or the time spent out of the labour force far outweighs the direct effect (i.e. reduced employment probability when children are present) of children on women's labour force participation dynamics when looking at the probability of a mother of a young child working full-time.

The time spent out of the labour force may provide one explanation for the commonly found family wage gap or the pay differential between women with children and childless women. Research on the family wage gap has been conducted by, for example, Harkness and Waldfogel (1999) and Viitanen (2004) for the UK. Harkness and Waldfogel (1999) find that among a sample of seven countries, UK displays the largest wage penalties to children, which is partly due to the higher propensity for UK mothers to be employed in low-paid part-time jobs. Career interruptions and the greater incidence of part-time employment due to childcare responsibilities may be reduced by a policy that makes childcare cheaper and more widely available to parents hence leading to a reduction in the

wage gap between women with children and childless women (for discussion, see also Jaumotte, 2003). The effectiveness of such a policy depends on how responsive the labour force participation of mothers is to the price of childcare.

The socially optimal strategy for the governments may be to boost the childcare industry because of the potential impact for reducing inequalities that result from the high costs of raising children (see, for example, Lissenburgh, 2000 for UK evidence) or raising the overall productivity of the economy. Bloom and Steen (1990) examine the economic impact of increased social investment in the childcare industry and find that expanding the childcare industry will help employers cope with a range of personnel problems they face in a labour shortage economy. Expanding the childcare industry will also enhance the productivity of workers via reduced absenteeism and reduced job related stress in their study.

This thesis concentrates on the aspect that childcare facilitates the employment of mothers of young children. Hence the next section presents an economic model of labour force participation and how the childcare dimension can be incorporated within this basic framework. I also describe basic models of demand, supply and price determination and how government intervention such as subsidies or vouchers would affect the equilibrium.

Section 1.4 examines the demand side of the childcare market while section 1.5 analyses the supply side of the market. Appendices 1 and 2 describe the childcare markets in the UK and in Finland respectively. Section 1.6 summarises

the studies that try to estimate the childcare market equilibrium. Section 1.7 summarises the impact of quality on child development and the determinants of childcare quality. Section 1.8 tries to shed light on why there are such large differences among western economies in their approach to public policy towards childcare.

1.2 Economic model of childcare and labour force participation

The economic model underlying the empirical work in this thesis is a basic static labour supply model adapted to account for the presence of children. This model is set within the wider framework of "new household economics" with its gendered divisions of labour (Becker, 1981, 1996). Becker theorises that the gendered division of labour results in within households specialisation in order to maximise the returns to human capital. This joint production function usually leads men to work on the labour market and women to specialise in household production and childcare. The research in this thesis focuses on married women's participation decision based on an individual choice model treating the husband's participation as exogenous[11]. As the services for childcare can be bought outside the household, the household makes cost-benefit decisions regarding the gendered division of labour taking into account the availability and cost of childcare, which is compared to mother's potential income from paid work.

[11] The collective model of household labour supply decisions (see, for example, Chiappori et al., 2002) may be a more appropriate approach to this problem, however, it is beyond the scope of this thesis.

The basic model is augmented with the childcare dimension to examine the joint decision regarding the mother's labour force participation and their use of formal childcare. Theory suggests two alternative approaches to understanding the impact of childcare on women's employment, first, it affects the value women place on their time at home (Blau and Ferber, 1992) and, second, the cost of childcare can be viewed as a tax levied on mother's wages so that higher-priced care would have the same effect as lower net wages (Connelly, 1992 and Michalopoulos et al, 1992). Both approaches predict that a lower price of childcare is associated with increases in the labour force participation probabilities of mothers of young children.

There are two different approached to modelling childcare. The first one involves childcare costs in the budget constraint. The underlying assumptions in this approach include that maternal care and formal childcare are perfect substitutes and that there is a fixed link between the hours of work and the hours of childcare utilised. The second approach, which is adopted in this thesis, assumes that childcare arrangements have an effect on the mother's utility. Formal childcare forms part of the production function for childcare quality, which in turn enters the utility function. The subsequent analysis rests on the assumption of imperfect substitutability of maternal care and formal childcare in the production of childcare quality as well as the omission of a direct link between working hours of the mother and the hours of formal childcare used.

Entering the childcare arrangements in the utility function affects the budget constraint and hence the reservation wage of the mother.

The following theoretical model is based on the analytical framework outlined in Connelly (1992). The model assumes that the mother is married or cohabiting with the partner present in the household and that there exists at least one pre-school age child. In a typical labour supply model, mothers maximise their utility subject to a budget constraint and a time constraint. The utility function can be formalised as follows

$$U=U(G,Q,L) \tag{1.1}$$

where G represents consumption goods, L is the mother's leisure and Q is the quality of childcare. The labour force participation of the father is assumed predetermined and hence exogenous. The quality of childcare depends positively on the amount of time spent in maternal care, C_m, and the amount of time spent in formal, non-maternal childcare arrangements, C_n. The average total quality of care over N children in the household can be written as

$$Q = Q_1 C_m + Q_2 C_n \tag{1.2}$$

where Q_1 and Q_2 represent the productivity measures of, respectively, maternal and non-maternal childcare, and N is taken as exogenous. According to this approach, the families do not have direct, observable preferences for formal or for informal childcare.

The mother's maximisation problem is subject to three constraints. The budget constraint can be formalised as follows

$$G + PC_n = WH + Y \tag{1.3}$$

where P is the hourly cost of formal childcare, W is the wage rate of the mother, H is the number of hours worked by the mother and Y is the household income excluding mother's own earnings.

Time constraints are imposed both on the mother and the children such as

$$H + C_m + L = 1 \tag{1.4}$$

$$C_m + C_n = 1 \tag{1.5}$$

where the mother allocates her time between hours worked in the labour market, leisure and childcare, while the child's time is divided between care at home and formal childcare arrangements. For a given set of preferences, family and taxation policies, for example tax credits for childcare, affect the mother's budget constraint while, for example, flexible working arrangements, affect her time constraint. Government policy can therefore affect women's participation probabilities.

Maximising the mother's utility function subject to the constraints yields a prediction that the mother will participate in the labour market according to

$$\frac{U_L}{U_G} = W = \frac{U_Q}{U_G}(Q_1 - Q_2) + P \qquad (1.6)$$

where the marginal rate of substitution between market goods and leisure equals the wage, which equals the net benefit of maternal childcare. The model predicts that women participating in the labour market equate the market wage to her reservation wage.

A further prediction of the model is that the mother will substitute between formal and maternal childcare until her wage rate equals the net benefit of maternal childcare. Hence an increase in the wage rate of the mother is expected to increase the probability of labour force participation, while an increase in the price of childcare is expected to lower the probability of labour force participation. This approach relies on the assumption of a functioning market system where the parents' willingness to pay determines the amount of childcare they purchase.

The predictions of the theoretical model outlined above provide a basis for an empirical choice model. The value of the time spent outside of the labour force, the reservation wage, depends on non-working income and domestic commitments, for example, the presence of children in the household. Once the anticipated income exceeds the reservation wage, W^*, the individual will enter the labour market. Formally:

$$\begin{cases} LFP = 1 & if \quad W^{*} < W - P \\ LFP = 0 & otherwise \end{cases} \tag{1.7}$$

Hence the participation probability is lowered due to the increased level of the mother's reservation wage. However, the increase in P has an ambiguous effect on hours worked and childcare used if the mother stays employed. On one hand, work is financially less rewarding and higher P induces a substitution of work hours with leisure hours. On the other hand, higher P reduces net income and she may want to work more hours to make up the loss. Although the theoretical model leaves open whether the income or the substitution effect is dominant, it is generally believed that higher childcare costs reduce female labour force participation.

The model can be written as in Equation (1.2), where *USE* denotes the dichotomous choice for the use of formal childcare and *LFP* denotes the labour force participation of the mother. *USE* and *LFP* are determined simultaneously. The identification of the model is obtained by using separate identifying variables in each equation. Formally:

$$\begin{cases} USE = \alpha_1 + \beta_{11} W + \beta_{21} P + \gamma_1 X + \varepsilon_1 \\ LFP = \alpha_2 + \beta_{12} W + \beta_{22} P + \gamma_2 X + \varepsilon_2 \end{cases} \tag{1.8}$$

where W is the wage rate, P is the price of childcare and X denotes individual, household and regional characteristics. The price is a function of childcare quality, however, this model ignores the childcare quality aspects and assumes

they are unobservable, but uniform (see Blau, 2001 for extensive discussion on the impacts of childcare quality when the quality is observable). This simple model also assumes that the supply of childcare is fixed in the short-run. This allows the use of basic supply and demand analysis.

The labour supply of mothers is dependent upon her gaining greater utility from working in the labour market that outside the labour market. Utility derived from working is a function of personal, market, and policy factors (see, for example, Killingsworth and Heckman, 1986 for a review). Variables such as the number and ages of children in the household and the presence of alternative, informal caregivers in the household affect the cost of childcare by providing an informal, low-cost alternative to formal childcare (see Heckman, 1974 for further details) and hence the probability of labour force participation. Furthermore, any government policy that affects the cost of childcare is expected to affect the labour force participation of mothers of pre-school age children.

The model suggests the following explanatory variables: wage rate, non-wage income, the price of childcare, and the availability of informal care. The model also draws attention to the fact that the price of childcare is a choice variable since it depends on the quality of purchased childcare chosen by the family. The importance of allowing for non-linearities in the price of childcare with respect to the quantity of childcare purchased is highlighted in previous research by, for example, Ribar (1995) and Duncan et al. (2001a). Ribar (1995) finds that childcare expenditures increase with hours of work but at a decreasing rate.

A higher wage rate (which depends on individual characteristics such as the level of education) is generally considered to encourage employment as it raises the hourly return to working, while higher partner's income or non-labour income reduce the likelihood of working by reducing the family's need for additional income.

The standard labour supply model has to be augmented with other variables when incorporating the childcare dimension into the model. These include, for example, factors influencing the amount of formal childcare needed, the availability of formal and informal childcare, the ability to afford the formal care, and the parents' and the children's preferences and tastes. Both the higher cost of childcare and the increase in the number of children requiring childcare decreases the probability of using formal childcare by increasing the reservation wage of the mother. Mothers can capture economies of scale if they stay at home but not if they rely on childcare (unless it is cheaper for additional siblings to be in the same formal childcare setting).

The availability of informal (zero-cost) childcare, such as other adults in the household or the neighbourhood (which is proxied by the amount of time lived in the current accommodation), or older children in the households, is expected to have a negative effect on the use of formal childcare. Higher potential earnings of the mother can be expected to have a positive effect on the use of formal childcare, while the impact of the partner's earnings on the decision to use formal childcare may be ambiguous due to the joint nature of the decisions to become

employed and to use formal childcare and the relative strengths of the income and substitution effects[12]. Important non-observed components of the decision to become employed or to use formal childcare include tastes and preferences, which can be proxied by age, ethnicity, and the level of education of the mother. Also, partner's years of education, hours of work, or earnings may affect these decisions due to, respectively, assortative mating, gendered division of labour within the household, or an income effect.

The estimation of the market equilibrium allows the calculation of elasticities. The main focus of research on childcare by economists has been to estimate the effects of the cost of childcare on the demand for childcare and the supply of labour by mothers of young children. This is an important issue because despite the rapid growth in labour force participation of mothers in recent years it is possible that some mothers remain out of the labour force partly as a result of high childcare costs. Increases in government subsidies to childcare might be expected to induce many women to enter labour force, however, this depends on the supply side of the childcare market as well as the demand side. If the supply of childcare is relatively inelastic, as found by Chevalier and Viitanen (2002), then increased subsidies may simply drive up costs rather than expand supply.

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[12] Mincer (1974) states that wife's potential income is more important than household or husband's income or in other words the substitution/wage effect predominates the income/household income effect.

1.3 Supply of childcare

Section 1.3.1 examines the informal childcare sector while section 1.3.2 sheds light on the formal sector of the childcare market mainly in terms of the supply of childcare labour.

1.3.1 Informal care providers

Informal childcare is most often provided by relatives such as partners, parents, and parents-in-laws. In 1994 half of British working mothers with children less than four years old used informal care for their offspring (Finlayson et al., 1996). Holloway and Tamplin (2001) estimate that the valuation of informal, daytime care for British children under 8 years old as a percentage of GDP ranges from 4 to 6 per cent between 1995 and 1999. However, in countries such as Finland with a large public childcare sector, the concept of informal childcare use for working mothers is virtually unknown.

Informal childcare provision has not received a lot of attention in the British research community. Instead the majority of previous literature on informal childcare providers has been conducted for the US. Brandon (1995) examines kin-provided childcare in the US and concludes that kin-provided childcare is an in-kind transfer, however, the choice to use kin-provided childcare is also affected by economic factors. He argues that policies aimed at reducing the cost of childcare may have unintended effects on the private provision of childcare within the families. For example, the kin who provided childcare in return for

goods and services may suffer losses if childcare subsidies lead mothers to substitute market-provided childcare for their care. Thus in-kind transfer behaviour within families can weaken or reinforce the effectiveness of childcare policies.

1.3.2 Formal childcare providers

Since the last 30 years have witnessed such a tremendous growth in demand for childcare, it is surprising that the wages of childcare workers have grown barely above the rate of inflation (see, Mocan and Viola, 1997 for further details). Since a large increase in the demand for childcare has not driven up the wages of childcare workers, this suggests that the supply of childcare labour is highly elastic. In other words, as demand grows, the quantity of labour supplied expands along with it dampening the tendency for the demand increase to drive up wages.

Estimates for the elasticity of supply of labour to childcare for the US range from 1.2 to 1.9 (Blau, 1993) or 1.15 (Blau, 2001) i.e. a 10% increase in the wage rate of childcare workers, holding constant the wage rate in alternative occupations, would increase the total number of childcare hours worked by 11.5% accounting for both new entrants to the sector and increased hours by workers already in the childcare sector. These parameter estimates could explain why childcare workers' wages tend to remain unchanged in real terms despite rapid growth in the demand for childcare.

Another possible reason for the childcare workers wages not to have risen faster is that the providers have hired less-qualified staff. Walker (1992) finds that childminders in the US receive no returns to experience or to education. Hence, well-educated individuals have no monetary incentive to enter the profession and low-educated providers have no incentive to upgrade their skills. The increased educational requirements for the childcare profession, which are desirable to increase some aspects of the quality of care (see, for example, Currie and Hotz, 2001), may therefore have serious effects on the supply of formal childcare.

Government subsidies for formal childcare and its regulation in the form of, for example, child-staff ratios may have an impact on the supply of childcare labour. However, Blau (1992) finds that in the US the childcare workers wages are generally unaffected by government subsidies and regulations, which suggests that the supply of childcare labour is relatively elastic.

Blau (2001) concludes that, for the US, the quantity and quality of childcare are quite responsive to the price of childcare. Also as the childcare price rises, childcare providers increase the quality of care they provide with the price elasticity of quality supply of 0.66 in the for-profit sector and 0.48 in the non-profit sector.

One potential explanation for the highly elastic supply of childcare labour may be the intrinsic value of work. Mocan and Tekin (2000) find evidence of

labour donation hypothesis in the childcare sector. In other words, childcare workers often express that their work is important from the society's point of view and that someone has to do it, even for a lower pay. However, the childcare sector suffers from a high rate of employee turnover, which may provide at least a partial explanation for the previously found elasticity figures (see Kimmel and Connelly, 2003 for US evidence).

In the UK, similar issues are prevalent. In the survey of childcare students and workers, over 90% of the students and workers are committed to working in the childcare industry and report a high satisfaction with childcare work (Cameron et al., 2001)[13]. However, the industry suffers from a high turnover: 1/3 of nursery schools had at least one vacancy and ¾ of nurseries had at least one member of staff leaving in last 12 months prior to the survey. Fourteen percent of the surveyed workers were considering leaving their work shortly because of the poor pay, however, most commonly quoted reason for staying on the childcare occupation is the satisfaction the work brings and commitment to it. However, only 48% of the surveyed childcare staff pictured themselves working in the childcare industry in five years time (Cameron et al., 2001).

The UK government funding for early years services has a needs component but none of it has been earmarked for childcare provision. Hence government

[13] The survey examines the characteristics of UK childcare workers and finds that the average age of a UK childcare worker is 32 with 1/3 being less than 26, ½ have their own child and just over a half have a teaching, nursing or vocational qualification. Two-thirds of the childcare workers work full-time and the mean annual salary before tax was £13,400 for heads of childcare centres and £7,700 for others.

policy on its own cannot explain the variation in the availability of childcare places. However, in the UK, there is a general trend for more deprived local authorities to have more day nursery places, for example, in the 1990's the most deprived quartile enjoyed nearly three times the number of total nursery places compared to the least deprived quartile. However, this is opposite for playgroup provision and childminders. Central government provides guidance on which groups (for example, according to the level of deprivation) should be given priority when allocating local authority day nursery places.

Interestingly, in the UK, there is a statistically significant positive relationship between the proportion of women councillors in the local authority and the overall local authority provision of childcare between 1984 and 1994 (Randall and Fisher, 1999). Mean rate of total childcare provision is the highest in Conservative controlled local authorities but median rate is highest in local authorities with Liberal Democrat majority control. However, the relevance of political party for rates of public day care provision has declined over the last two decades.

All the findings on the labour supply of childcare workers indicate that, both in the US and the UK, there exists a potentially large and committed labour force. However, for many potential childcare workers the low wage rate acts as a disincentive to continue to work in the childcare sector, particularly after becoming mothers themselves.

1.4 Demand for childcare and the labour supply of mothers

This section summarises the main findings of empirical studies of consumer behaviour in the childcare and the labour market. The theoretical section 1.2 explained that the labour force participation of mothers is closely related to the demand for childcare; therefore these two issues are analysed together in this section. The price of childcare and the wages are the key variables through which government policy attempts to influence consumer behaviour in the form of, for example, childcare subsidies or tax credits. Hence the predictions of these models are of direct policy interest.

The simple economic model in section 1.2 makes predictions of the effects of the price of childcare and income on the use of formal childcare and mother's labour force participation. To recap, we would expect the price of childcare to reduce the likelihood of using formal childcare but to have an ambiguous effect on labour force participation. Appendix 3 includes a table summarising some of the previous studies that estimate the childcare price elasticities with respect to the use of formal childcare and the labour supply of the mothers of pre-school age children.

Appendix 3 shows that out of the 27 previous studies only Del Boca et al. (2003) for Italy find no significant effect of the price of childcare on the use of childcare; the rest of the studies find the expected negative impact of the price of childcare on the probability of its use. The majority of the previous studies also

find that the higher price of childcare reduces the labour supply of the mothers of young children. Only four separate studies (Blau and Robins, 1991 and Hotz and Kilburn, 1991 for the US; Choné et al., 2003 for France; Del Boca et al., 2003 for Italy) find no significant effect of the price of childcare on the labour force participation probability of the mother. Furthermore, Connelly (1989) finds a significant impact for single mothers only.

Hence the majority of studies find that a higher cost of childcare both reduces the likelihood of employment as well as the probability of using formal, paid childcare. Some of the insignificant results that are found especially for Europe could reflect the cultural differences with respect to the attitudes toward female employment and the care of young children in a formal setting. Furthermore, European countries, in general, experience much more government intervention in the childcare market than the US for example.

Although most of the studies find consensus on the sign of the effect, the magnitude of the impact of the price of childcare varies widely among the existing childcare literature. The wide range in the empirical results is not surprising given the vast differences that exist with respect to modelling and estimation issues. First, many papers focus solely on either the employment decision or the use for childcare decision. Second, large differences exist in the approach to the sample selection correction and especially the choice of identifying variables in the supporting childcare price equations. Furthermore, small but a growing number of studies utilise a more structural approach to

estimate these issues (see, for example, Choné et al., 2003 for France or Wrohlich, 2004 for Germany).

A range of studies concentrates on the effect of the price of formal childcare on the labour supply decisions of mothers of young children. Appendix 3 indicates that the previous literature on the joint estimation of labour supply and use of formal childcare utilises numerous different estimation strategies.

Most studies estimate a labour supply equation with expected childcare costs as an explanatory variable. Heckman's (1974) pioneering article reminds us that many working mothers use informal modes of childcare such as care by relatives for low or zero cost. Hence the decision to enter the labour market is not automatically a decision to use formal childcare but instead it depends on the relative weight of the cost and quality of formal childcare versus the cost and quality of informal care. Heckman concludes that the quality-adjusted price of childcare has a significant positive effect on the marginal rate of substitution hence decreasing mothers' labour supply. Studies by, for example, Connelly (1990, 1992), Hotz and Kilburn (1991), Kimmel (1995, 1998), Powell (1997, 1998) and Averett et al. (1997) have confirmed the significant negative relationship between female labour force participation and the price of childcare. In general, the empirical method within this group of studies involves an estimation of an employment equation, which includes selectivity-corrected,

predicted childcare prices and wages[14]. The price elasticity of demand for childcare with respect to employment ranges from –0.20 to –0.78 in studies by, respectively, Connelly (1992) and Averett et al. (1997) or –0.92 by Kimmel (1998). In other words, decreasing the market price by 10% would lead to an increased likelihood of employment for mothers of pre-school age children varying between 2% and 9.2%. Higher childcare costs hence seem to have a significant negative employment effect for mothers of pre-school age children.

Another group of studies estimates the joint decision of mothers of pre-school age children to engage in paid employment and to purchase formal childcare. The research by Blau and Robins (1988, 1991), Michalopoulos et al (1992), Ribar (1992, 1995), Powell (2002), and Cleveland et al. (1996) highlight the interrelated nature of the employment decision and the decision to use formal childcare. The childcare price elasticity for married women found by these studies ranges from –0.02 by Ribar (1995) to –0.39 by Cleveland et al (1996) and –0.74 by Ribar (1992). In other words, decreasing the market price by 10% would lead up to a 7.4 percent increase in the probability of mothers of pre-school age children engaging in paid employment. These papers also find that higher childcare costs significantly reduce the likelihood of using formal, paid childcare[15]. Based on all the previous studies it appears that accounting for the joint labour force participation-use of childcare decision the elasticities are reduced.

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[14] Several studies use measures of labour supply with indirect proxies (e.g. older children in the household, relatives in household) for the cost of childcare, see, for example, Blau and Robins (1988, 1989, 1991) who use the average childcare costs in the community.

[15] The mode of childcare chosen is also found to depend on the age of the child (Leibowitz et al. (1988, 1992) and Lehrer (1983, 1989)) and the presence and number of siblings (Lehrer (1989)).

Duncan et al. (2001), for the UK, find that the price of childcare has a negative impact on the decision of a sample of working mothers to use formal paid childcare and on the hours of formal care used. The elasticities for the former range from –0.26 to –0.45 for pre-school age children using different measures of the price of childcare. The elasticity with respect to the hours of formal care used is over –0.20 without the controls for hours and quality, however, once the unit values are corrected for the choice of hours and quality, the elasticity estimates become insignificant. Duncan et al. (2001) stresses the importance of controlling for quality effects and non-linearities in the price of childcare since the failure to do this may generate significant overestimates of the price elasticities. Their evidence suggests that the price of childcare is negatively related to quality. Therefore, subsidies aimed at lowering the price of formal childcare may increase childcare expenditures by increasing the quantity demanded and raising the level of quality purchased.

On average, the price elasticity of demand for childcare with respect to employment is estimated to be higher in absolute terms in the North American studies compared to the rest of the world. Furthermore, the US studies overall estimate American mothers' employment to be slightly more responsive to the price of childcare compared to the Canadian mothers. Similar differences are found between the North American studies and those of the rest of the world regarding the childcare price responsiveness with respect to the use of formal childcare. These results may reflect both institutional and cultural differences in

female labour supply behaviour and, in particular, the differences in childcare provision. In general, the American childcare system is based more on the ideals of a free market economy with few subsidies or public provision, whereas especially in Europe government intervenes in the childcare market more systematically (for further discussion, see for example Blau, 2003). The lack of evidence for the Nordic countries, where low-cost, public childcare is prevalent, prevents one from further examining this hypothesis.

In general, single mothers are found to exhibit less responsiveness than married mothers in their labour force participation due to childcare prices (Berger and Black, 1992 and Kimmel, 1998). An exception to this common finding is that of Connelly and Kimmel (2000) who conclude that employment elasticities are larger for single than married women. Unfortunately, the data used in this thesis does not allow the analysis to be conducted for single mothers (the UK data used in Chapters 2 and 3 is discussed in Appendix 4, while the Finnish data used in Chapter 4 is discussed in Appendix 6). However, keeping in mind the findings quoted above for the differences between single and married women's results, the childcare price elasticity of employment can be expected to surpass that found by Jenkins and Symons (2001) for the UK. They find a much lower price of childcare-employment elasticity for the British lone mothers (-0.09) than most other similar studies that are conducted for both married and single mothers (-0.2 to -0.92 for married women and –0.22 for single women).

Furthermore, Kimmel and Powell (2001) find that the decision to become employed in a non-standard job (for example, shift work, night shifts etc.) is less responsive to the price of formal childcare. This implies that childcare subsidies are likely to help mothers working in "standard" working arrangements. Being a non-standard worker significantly reduces the likelihood of using formal modes of childcare, which in general are less likely to offer flexible childcare arrangements.

The papers reviewed in this chapter find that higher childcare costs significantly reduce the likelihood of using formal, paid care by posing a significant barrier to employment for single and married mothers. Furthermore, higher childcare costs may also lead to an increased rate of leaving employment (Blau and Robins, 1989). Column 8 of the table in Appendix 3 summarises the empirical evidence from the previous literature supporting the theoretical expectation of higher childcare costs having a negative impact on the labour supply of mothers of young children.[16] The reported estimates for childcare price elasticities for employment range from –0.09 to –0.92. The findings of these econometric studies are in accordance with the findings of the Daycare Trust but also both quantitative and qualitative survey results (Bloom and Steen, 1990; Cattan, 1991; Mason and Kuhlthau, 1992; Paull and Taylor, 2002; and the

[16] Some exceptions to the usual finding of childcare costs imposing a negative effect on the labour supply of mothers are by Blau and Robins (1991) who find a positive but insignificant result. Additionally, Hotz and Kilburn (1991), and Leibowitz et al (1992) have mixed results.

Daycare Trust) indicating that a substantial number of women would like to work if there were suitable, reasonably priced childcare available.

However, qualitative research may lead us to conclude that price and income subsidies may not be effective for all parents. This is especially true for those living with a partner, being out of the labour force, believing in traditional gender role ideology and attending religious services frequently (Mason and Kuhlthau, 1989) for the US and a disinterest in non-relative care, regardless of its price or non-maternal income (Joesch and Hiedemann, 2002) for Germany. This result is enforced by quantitative analysis by Powell (2002), who separates between the different modes of childcare and finds that relative care is less price sensitive compared to centre and childminder care.

Finally, it must be noted that the majority of the studies examining childcare markets are based on US experiences with a few UK studies. Both countries are characterised by limited availability of publicly provided childcare. The question of the affordability of childcare may lose some of its importance in the context of a day care system that is characterised by a high share of public provision and a rather unimportant private childcare market. Instead the availability of childcare slots may be relevant to policy discussion in countries such as Germany (Kreyenfeld and Hank, 2000). It would be desirable to more systematically examine the childcare question in the European context to examine to what extent the institutional settings affect the magnitude of the childcare price elasticities.

However, at this point, no conclusion can be reached regarding this issue due to the small number of studies conducted for countries other than the US or Canada.

The main findings in this section are that a decrease in the price of childcare increases the quantity of childcare demanded and the employment probability of mothers of pre-school age children. However, Blau (2001) concludes that neither the decrease in the price of childcare nor a rise in mother's wage rate increase the quality of care demanded, which contradicts the finding by Duncan et al. (2001). I will next summarise the findings on the existing research on the quality of childcare.

1.5 The quality of childcare

Blau (2001) provides an extensive overview of the childcare market in the US with a large concentration on the issue of childcare quality. The quality of care has also formed part of the analysis in several pieces of economic research[17].

The quality of childcare could have profound long-term implications for the society at large if it has an impact on the child's emotional and cognitive development. Quality of childcare can be measured in two main ways: 1) process quality i.e. what actually occurs in childcare settings, for example, language stimulation, health and safety measures and 2) structural characteristics, for example, child-adult ratio, training of caregivers and the group size. Important

[17] See, for example, Berger and Black (1992), Michalopoulos et al. (1992), Hagy (1998) and Blau and Hagy (1998).

issues to consider include, first, the effect of childcare quality on children and, second, the determinants of childcare quality.

Ideally investment in childcare yields net benefits to society by enhancing the human capital of upcoming generations and reducing inequalities due to family background. Vandell and Wolfe (2000) and Waldfogel (2002) provide comprehensive literature reviews examining the effects of childcare on child development. None of the reviewed studies provide any definite answers. The main body of research has moved focus from examining whether childcare and early maternal employment are detrimental to child development to assessing which type of childcare can provide most benefits to children's cognitive and socio-emotional development.

Blau and Mocan (1999) find that, on average, the parents of young children are unwilling to spend significantly more on formal childcare in order to obtain higher quality care. They find that the supply of quality is inelastic for both profit-making and non-profit firms. Blau (2001) reasons that parents may not value childcare quality in the terms defined by developmental psychologists or that they may simply not have enough information to assess the quality of a childcare provider.

The traditional measures of quality, such as the child-staff ratio or the group size have in the recent years come under attack in the academic circles. Blau (1998, 2000, 2001) finds that the easily observed inputs, such as the group size,

child-staff ratio and teacher qualifications, are correlated with childcare quality, however, there seems to remain a lot of unmeasured centre-specific heterogeneity in the quality of formal childcare. Hence Blau's results raise questions about the chances of public policy to influence the quality of childcare through regulation and childcare subsidies.

Furthermore, Mocan (2001) compares consumer evaluations of quality to actual quality and finds that parents do not utilise all the available information in forming their assessment of quality. The parents of young children may suffer from information asymmetry, which is exhibited mostly by the parents interpreting the signals of quality incorrectly, for example, equating clean reception areas with high quality of childcare. However, Mocan (2001) finds some evidence of moral hazard whereas the centres with clean reception areas tend to produce lower level of quality for unobservable items. These results provide a partial explanation for the low average quality in the childcare market.

Mulligan and Hoffman (1998) argue that in the absence of significant increases in government support, the only feasible method for accommodating more children in formal childcare rests with higher child-staff ratios. Policy makers are given the advice that regulation of child-staff ratios, group sizes and qualification levels is too blunt an instrument for improving the overall quality of childcare. By focusing on outcomes rather than inputs, childcare providers should be free to choose among different combinations of these inputs.

The child-staff ratio is not significant for the employment decision of the British mothers and larger provider size is associated with higher proportion of mothers working full-time rather than part-time or not working at all for all forms of childcare except for childminders, which may reflect quality issues (Paull and Taylor, 2002). Furthermore, it is possible that in the UK parents do not have a choice regarding the quality of childcare due to its low availability. Hence, the issue of quality may become more relevant only when the childcare market reaches the equilibrium.

A commonly used method to correct the unit prices for the choice of quality is the hedonic pricing model originally developed by Rosen (1974). However, the chapters within this thesis ignore the quality aspect of childcare altogether hence any price estimates may be biased as a consequence. The reasons for not using the hedonic techniques to correct the price of childcare for the quality of care chosen include the following: 1) the UK childcare market consists of sub-markets, for example, the public and the private childcare provision, which cannot be identified in the data, 2) there may be possible problems with the identification of the hedonic model, and 3) there may be a reason to believe that the UK childcare market is in a disequilibrium, which would possibly result in inconsistent results. For further discussion on the estimation or the identification of the hedonic models, see Heckman et al. (2003) or Ekeland et al. (2002) respectively.

Overall, the previous research on the quality of childcare has not reached any agreement. Blau and Mocan (2002) for the US find that parents are unwilling to

pay more for higher quality childcare, a result which reinforces the finding of Blau (2001) that the relationship between family income and quality of care is almost non-existent. Since the use of hedonic models requires a more detailed knowledge of the underlying market structure (see Ekeland et al., 2002 for discussion), this method is not utilised in this thesis. One has to keep in mind though that if the quality and the price of childcare are strongly correlated in the UK childcare market, the estimates in this thesis may be biased.

None of the childcare literature has examined the overall costs and benefits to the society in terms of whether additional government expenditure on childcare is justified given the magnitude and the nature of the social benefits they yield. The next section examines the arguments that have been put forward for the governments to intervene in the childcare market.

1.6 Government intervention in the childcare market

Government intervention in the childcare market varies considerably between countries. The US and the UK follow mainly the non-interventionist approach by allowing the market to operate freely and privately with only a few subsidies, which are mainly targeted at the low-income households. The role of the state is limited to ensuring minimum quality standards among the childcare providers. An example of the other extreme of the level of government intervention in the childcare is provided by the Nordic countries. In the Nordic countries the large

public provision of childcare in general guarantees every pre-school age child a place in a high-quality, low-cost childcare setting regardless of the family income.

The *laissez-faire* approach that is prevalent in the US and the UK relies on the notion that having children is a private decision. The possible career break effects and the resulting lower income, according to this view, should be factored into the decision to have children. On the other hand, both private and social economic gains can be expected from governmental intervention in the childcare market. Bergstrom and Blomquist (1996) state that the differences in the public policy configurations regarding childcare are due to the political climate of the country. In other words, the Nordic countries, according to their argument, are more willing to accept a system of high taxes and redistribution than the US and the UK.

There are two main justifications for the government to intervene in the childcare market according to the basic principles of welfare economics. The first concerns inefficient resource allocation and argues that the government should intervene to correct any imperfections that prevent the childcare market from working efficiently and maximizing consumer welfare. Market failures in the demand for childcare services include information failures or imperfections in capital markets. In the former case, families fail to gauge the financial losses of career breaks and/or perceive the benefits of formal childcare. In the latter case, the cost of childcare might, in the short run, be greater than the immediate returns from employment. Hence, the *laissez-faire* approach to the childcare markets

might be improved by correcting some of the imperfections by intervention as long as the benefits to society exceed the private benefits to parents.

The second justification for government intervention in the childcare market concerns inequality. The distributional issues in childcare use, for example, the equality of opportunity in society provides a strong argument for government intervention in the childcare market. This argument regarding inequality has two parts. First, there may exist inequality in the mothers' ability to participate in the labour force compared to women with no children or school age children. Second, intervention in the childcare market may be required to aid children to get an equal starting point in life regardless of the household financial status (see, for example, Duncan and Giles, 1996 or Carneiro and Heckman, 2003 for further details). In general the Nordic countries have less child poverty, a smaller gender wage gap and more similarity in the educational outcomes between different socio-economic groups (see, for example, the PISA 2000 study by OECD) than, for example, the US or the UK.

Previous research indicates that there are large differences in the private returns on remaining employed between the interventionist and the *laissez-faire* approach. Gornick et al. (1998) find results that demonstrate a strong association between policy configurations regarding parental leave and childcare and the employment patterns of mothers. Out of the 14 industrialised countries analysed, wage penalties for mothers are the greatest in countries with the least-developed

public policies for supporting the employment of mothers with young children, namely, the US, Australia, and the UK.

These arguments point to the possibility that the outcomes of the free childcare market may have distributional implications that the society would prefer to avoid. Duncan and Giles (1996) further note that through examining the reasons why the government would want to subsidise childcare helps in understanding which type of public policy might be desirable. Universal subsidies may result in high private and social returns, however, they are in general costly to the government and hence the tax-payers and, additionally, result in large dead-weight losses. In the end, the ideal balance in terms of economic efficiency is found by weighing both the private returns and the social returns and finding the balance between the extremes of the public intervention approach and *laissez-faire* approach to the childcare markets.

The Nordic countries are characterised by low level of monetary support for families compared to the other European countries as found by Kurjenoja (2001), who compares the level of monetary support for children in 10 European countries. However, this low level of direct monetary support for pre-school age children is compensated by publicly provided childcare. Since the universal public provision of childcare prevalent in the Nordic countries is designed to provide every pre-school age child a low-cost care place regardless of the family's ability or willingness to pay for the care, there is potential for large deadweight losses for the economy as a whole.

Publicly provided private goods such as childcare are closely related to labour supply and hence government tax revenue. It is possible that public subsidies for childcare "pay for themselves" by inducing higher labour force participation of mothers who then pay taxes that are more than sufficient to pay for the cost of the subsidies.

The direction of the labour supply response to childcare subsidies is not clear. The subsidies increase the returns to every hour of paid employment thereby improving the incentives for individuals to increase paid employment (the substitution effect) but they also reduce the number of hours of paid employment necessary to achieve a given material standard of living or the number of hours of childcare (the income effect). On the producer side, the supply side effects of childcare subsidies include the promotion of additional supply of childcare places depending on market conditions, for example, the consumers' willingness to pay for care and existing competition from other providers and the barriers to entry. The impact of childcare subsidies on the demand and the supply side regarding the quality of childcare is unclear as outlined in section 1.5. The difficulty in measuring the quality of childcare may speak in favour of the interventionist approach to childcare provision rather than the free market approach due to problems of moral hazard and adverse selection (for discussion see Akerlof, 1970).

Studies examining the impact of monetary support find a positive effect on the employment probabilities for both single (Berger and Black, 1992) and married

mothers (Powell, 2002). Subsidies targeted at formal care and unconditional childcare subsidies were found to have the greatest potential in terms of increasing employment. Furthermore, Leibowitz et al. (1992) find that greater monetary support for childcare increases early return to work after childbirth in the US. For the UK, Forth et al. (1997) find that family friendly working arrangements (for example, increased flexibility in childcare arrangements or a workplace crèche) have a positive influence on the rate of women's return to work after childbearing.

Lehrer (1983, 1989), for the US, finds that unless subsidies to formal care are means-tested they may result in benefits that mostly accrue to high-income families. However, in Sweden the large public childcare provision is found to encourage the labour market activity of mothers of young children regardless of the spouse's income (Bloom and Steen, 1990 and Gustafsson and Stafford, 1992). The difference between the Swedish and the US experience also reflects the issues of availability and affordability of childcare but also, to a certain extent, the differences in the quality of childcare (real or perceived) available in the interventionist *versus* the *laissez-faire* childcare markets.

Childcare subsidies in general can be designed to encourage employment or to enhance the quality of childcare. These goals are generally in conflict: policies that encourage employment would allow parents flexibility in the choice of the quality of childcare and policies that are most likely to encourage the use of high-quality childcare would not impose employment requirements. Blau (2001)

believes that the main problem with the childcare market in the US is low quality. Hence childcare subsidies with an employment prerequisite are likely to worsen the childcare problem by increasing the use of low quality care.

However, the problem in general is to find the middle road between the two extremes. The social returns to public childcare provision are hard to quantify hence making any accurate cost-benefit analysis impossible. Furthermore, no analysis has been done to balance the deadweight losses of public childcare provision against the higher female labour force participation and hence higher tax revenue in these countries.

1.7 Conclusions

The previous research on the economics of childcare leads us to conclude that there is no consensus on the effect of the price of childcare on the demand for childcare and that the quality of childcare is difficult if not impossible to measure. Furthermore, different countries have adopted different approaches and levels of government intervention to help their citizens to balance working life with family commitments.

This thesis does not examine the issues of childcare quality due to the lack of appropriate data. Instead I will try to shed light on the effects of the price and the availability of childcare on the labour force participation and use of childcare by mothers of pre-school age children.

Another issue of increasing importance, especially in Europe, is to increase fertility. This is the traditional argument put forward, for example, in France to justify higher expenditure on pre-school age children. The social returns of increased fertility are noticeable with the looming pension problem and the increasing dependency ratio across the European countries. However, this thesis does not examine the impact of childcare policies on fertility.

Most of the previous research in the field of childcare has been done for the US. This thesis concentrates on the UK childcare market that has not received as much attention as the US childcare situation. Hence the issues analysed in this thesis should be relevant to the current policy debates in the UK. An examination of the Finnish childcare market in the final chapter provides alternative approaches to dealing with the childcare problem and provides evidence on the effect of introducing competition in an interventionist system.

CHAPTER TWO:

2.1 Introduction

"British childcare is worst in Europe" states a headline in The Independent newspaper (2.9.2001). The claim is based on a finding that the childcare provision in Britain comes close to the bottom among the 15 EU member states using measures such as publicly funded nurseries and parental leave (Land, 2002). This finding is not good news for the current government that has been trying to get recognised for its family-friendly policies. The National Childcare Strategy, launched in 1999 by the Secretary of State for Education and Employment, promises to raise the quality of childcare, making it more affordable, as well as increasing its provision.

The government promises should be welcomed by the general public. A recent survey finds that 38% of parents think that there are not enough childcare places available and 43% say it is too expensive. According to the Daycare Trust, the typical cost of a nursery place is more than the average household spends a year on either food or housing. The government estimates that there are only 830,000 registered childcare places for the 5.1 million under 8-year-old children in England. Based on survey evidence Cameron et al. (2001) approximate that 100,000 nursery nurses work in Great Britain. As a comparison, in Finland in 1999 there were 48,500 childcare workers for the 427,688 pre-school age children. The provision of childcare has risen to the

agenda of politicians as women have increased their participation to the labour force. Thus, the potential shortage of childcare providers in the UK is likely to worsen with time as women are expected to fill 2/3 of all new job creations between 1998 and 2009 (Wilson and Green, 2001). Evidence of the difficulty to combine family and work are found in Paull et al. (2002) who report that 24% of non working women would like to participate in the labour force but feel hindered because of childcare responsibilities. The shortage of childcare facilities is also reflected in the high prices for the service and evidence of waiting lists (Callender, 1997).

In 1999 the UK government launched the Childcare Link help-line and website as part of the National Childcare Strategy to enable parents to easily find a childcare place in their neighbourhood. Consulting the website for a day nursery place in Holloway, part of the London's borough of Islington, the search found 42 day nurseries[18]. However, of the 42 nurseries only 8 reported immediate vacancies (on average two vacancies per day nursery, which were often only part-time places or reserved for a certain age group). Most day nurseries use waiting lists, which vary in length from a few months to several years.

The waiting lists for childcare may indicate that the childcare market is in a disequilibrium with an undersupply (excess demand) of formal childcare (see, for example, Blau, 1991 for further discussion). Empirical research on childcare and

[18] The search was done on 17.8.2004 on the following website: http://www.childcarelink.gov.uk.

its effect on female labour supply has usually ignored this aspect of the childcare market and assume perfect elasticity of the supply side of the market. One recent exception is by Chevalier and Viitanen (2002), who explore the causality between female participation and supply of childcare in Britain. Using aggregate data from the Labour Force Survey, they build an eight year time-series dataset and conclude that childcare Granger causes participation without feedback, which supports the claim that women could be constrained in their participation by the lack of childcare facilities. The absence of a feedback mechanism implies that the supply of childcare is inelastic and does not react to an increase in demand for childcare services. Equilibrium is therefore reached either by a price increase or by the formation of a queue, which is consistent with the stylised facts.

In this paper, we examine whether demand and supply of childcare are in a disequilibrium. Whilst there are evidence in the popular press of a shortage of childcare, there is no evidence regarding the extent of the disequilibrium. The difficulty is that available datasets report the use of childcare but not (in a systematic manner) the desire to use it at the current market price. To measure the queue for childcare, this paper use an econometric method, first proposed by Poirier (1980) and Abowd and Farber (1982), in which a binary outcome (using childcare or not) reflects the joint unobserved binary choices of two decision makers. In this case, a child is observed in childcare, conditional on the mother

demanding it and childcare being available at her reservation price; this is referred to as a partial observability model.

The childcare market is a sequential decision model with partial observability, as in Abowd and Farber (1982). First, the mother applies for a childcare place and joins a queue of demanders. Then, childcare providers select individuals out of the queue and offer places to individuals satisfying a decision rule (ranking on a first come-first served basis, a needs basis, or purely randomly). Only children who have been accepted are observed using childcare. After estimating the probabilities of demanding and receiving childcare, the size of the queue can be calculated. While these models have been used to measure queues for union or federal jobs (see Heywood and Mohanty, 1995 for example), we reckon that this paper provides the first application of partial observability estimation in the context of childcare. Determining the size of the queue and the childcare arrangement of queuing mothers allows conclusions to be made on the efficiency of an increase in childcare supply on the female labour supply.

Using pre-WFTC data, we find that the queue for childcare is large[19]. Demand for childcare is estimated to outstrip supply of childcare by 43%. Thus, increasing the supply of childcare would reduce this bottleneck and lead to an increase in the labour force participation of mothers.

[19] Unfortunately, the lack of consistent local authority childcare availability data prevents us from using the post-reform data (WFTC took effect on October 1999) in the analysis.

2.2 Economic model and econometric method

Models of the use of childcare typically compare the utility derived by the mother while using formal childcare and other forms of care. However, comparing utilities only determines the demand for childcare (Abowd and Farber, 1982). In a partial observability model, the supply side of the market is also included; the assumption is that the decisions are taken by two agents but only the joint outcome is observed. Thus, the final outcome reflects the equilibrium state of the market.

In the case of childcare, a child is observed in formal care if the mother wants to use childcare and a place is offered by a provider. A child is not observed in childcare if the mother wants to take care of the child herself or if the application of the mother to childcare is rejected by the childcare provider. Formally, the probability of using childcare is given by the formula below:

$$\begin{aligned} \Pr(USE_i = 1) &= \Pr(D_i = 1 \; and \; O_i = 1) \\ \Pr(USE_i = 0) &= \Pr(D_i = 0 \; or \; O_i = 0) \end{aligned} \tag{2.1}$$

where *USE* is the observed outcome of the use of childcare by mother *i*; *D* and *O* are unobserved and reflect respectively the demand for childcare and the offer of a childcare place to child *i*. A childcare offer is always accepted by a mother demanding formal care. To simplify the notations, we now drop the *i* subscript.

The two non-observed decisions D and O follow latent models such as[20]:

$$D = x_D\beta_D + \varepsilon_D$$
$$O = x_O\beta_O + \varepsilon_O \qquad (2.2)$$

Where x_D and x_O are vectors of characteristics explaining the demand and the acceptance of childcare. These vectors typically will contain household, and local characteristics. The random error terms (ε_D and ε_O) follow a bivariate normal distribution (0,0,1,1,ρ). The independence of the error terms depends on how the allocation of childcare is made by the provider. In a model where the allocation is done either randomly or on a first come-first served basis, the error term in the offer equation will be independent of that in the demand equation. On the other hand, if the allocation is made after the provider receives an application or interviews the parents, then it is likely that some of the unobservable characteristics explaining the choice of demanding childcare will be correlated with the unobservable explaining the decision of the provider to offer childcare to these parents. In the empirical work, we assume that the two error terms are correlated.

For the model to be identified at least one variable has to be unique to x_D or x_O. We rely on individual characteristics, the average price for formal childcare at the local authority level, and proxies for the quality of local authority childcare

[20] The offer equation implicitly suggests that childcare providers use a ranking system based on the individual characteristics rather than operate a first come/first serve basis. This assumption is not formally imposed in the empirical specification where identification comes from variations in the local supply and prices of childcare.

provision to identify the demand equation. Childcare being a normal good, we assume that higher mean price would have a negative effect on the individual demand for childcare.

The offer equation is identified with local authority level availability of childcare paid and free childcare, the proportion of women employed as well as council tax quintiles. The availability of childcare at local authority level is expressed as a ratio per 100 children for different types of providers. We assume that an offer is more likely to be made to individuals living in local authorities with a higher supply of care, regardless whether this is paid care or fee-free care. This model therefore implicitly implies that the total supply of childcare has no effect on the individual demand for the service. This assumption may be rejected if individuals faced with a low supply of childcare feel discouraged and do not apply. On the other hand, the previous discussion on the waiting lists for formal childcare indicate that mothers do not stop asking for childcare only because there is low availability of formal care in the local authority. Therefore supply would not affect the demand for childcare.

In a sequential-decision model with partial observability, the second equation in (2.2) is conditional on $D_i = 1$. Formally, the system of equations (2.2) is equivalent to:

$$\Pr(D = 1) = \Pr(x_D \beta_D > -\varepsilon_D) \tag{2.3}$$

$$\Pr(O = 1 \mid D = 1) = \Pr(x_O \beta_O > -\varepsilon_O \mid x_D \beta_D > -\varepsilon_D) \tag{2.4}$$

An offer for childcare is made only to mothers that were in the queue of women demanding childcare[21]. Thus, the distribution of ε_O only exists for $\varepsilon_D > -x_D\beta_D$ and conditional on being in the queue for childcare the error terms ε_D and ε_O are independent. The likelihood function to be maximised therefore has the following form:

$$L = \prod_{D=1}[\Phi(\beta_D x_D)\Phi(\beta_O x_O)] * \prod_{D=0}[1 - \Phi(\beta_D x_D)\Phi(\beta_O x_O)] \qquad (2.5)$$

The parameters β_D and β_O are estimable only if there is at least one non-overlapping variable in either x_D or x_O. This is a sequential decision model with partial observability as used by, for example, Abowd and Farber (1982).

Besides personal characteristics of the parents, the composition of the household is clearly an important determinant of the demand for childcare. Families relying on parental care can expect economies of scale when taking care of more than one young child. Those economies are not likely to be redistributed to the parents using childcare, thus we expect that more children will reduce the use of formal childcare. The age of the child affects the probability of relying on formal childcare in a positive way. First, mothers are guaranteed some maternal leave (see Waldfogel, 1998 for details) and the preference for taking care of one's own child may be higher, the younger the child is. Additionally, the provision of

[21] For a discussion on the differences between a simultaneous (as in Poirier, 1980) and sequential (as in Abowd and Farber, 1982) partial observability models, see Maddala (1983).

childcare for very young children is limited and pricier reducing the possibility of using childcare for infants less than two years old.

Mother's health may have ambiguous effects on the use of childcare. On one hand, if the health conditions reduce the probability of working then it may reduce the need for childcare. On the other hand, serious health problems may prevent the mother from providing care herself and thus increase the demand for formal childcare. The ethnicity of the mothers may also affect her choice of childcare, but the direction of the effect is likely to be specific to unobserved characteristics (mother's integration, proportion of non-white in the neighbourhood)[22].

We expect childcare to be a normal good and higher local prices should lead to a reduction in the use of childcare. Additional determinants in the demand equation are proxies for the quality of childcare, including the average pay, job tenure and education of childcare workers at the local authority level. The most important characteristic of the mother explaining her desire to use child care is whether or not she intends to join the labour force. Whilst the intention variable is not observable, we include mother participation to the labour force in the model. This variable is obviously endogenous but unfortunately there is no additional exclusion variable in the dataset that would provide identification.

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[22] Unfortunately the sample sizes is limited and does not allow to differentiate the demand of the non-white groups. Instead, we estimate a single effect for all non-white.

Besides household characteristics and personal characteristics of the parents, the offer of a childcare place is determined by local authority level variables on the proportion of women employed, proportion of pre-school age children and the proportion of racial minorities. The offer of a childcare place can also be expected to be higher in local authorities where there are more suppliers of childcare.

2.3 Data

The data comes from five waves of the Family Resources Survey (FRS) covering years 1993/4-1997/8[23]. The FRS is a continuous survey sponsored by what was previously known as the Department of Social Security (currently known as the Department for Work and Pensions) for policy monitoring and the costing and modelling of changes to national insurance contributions and social security benefits in Great Britain. The FRS includes a detailed questionnaire relating to benefits and childcare take-up and expenditure. Unfortunately, the childcare section is routed and only families with at least one working adult have to complete it.

We restrict our sample to mothers aged 18 to 59 with a least one child aged less than five (pre-school age), and drop families where no adult works. To limit the bias resulting from this selection rule, we drop lone mothers from the sample as only a small proportion of working lone mothers were observed. We define the

[23] The definition of some local authorities was changed after 1998 hence breaking the series for the local authority level of childcare data used in the analysis.

use of childcare as using any type of formal providers of childcare; a detailed breakdown of the childcare providers is reported in Table 2.1. Childminders and nursery/playgroups are the main providers of formal childcare, but schools are also extensively used. Working mothers used more formal childcare, especially childminders and nurseries/playgroups, but also more informal care.

Table 2.1: Main providers of childcare, %

		All mothers	*Working mothers*	*Non working mothers*
Formal	*Childminder*	10.4	17.0	2.4
	Nursery/playgroup	9.8	16.3	1.9
	Creche	0.6	1.1	0.1
	School	6.4	8.4	4.2
Informal	*Non-relative provider*	22.3	37.1	4.5
	Relative care	50.5	20.1	86.9
Total		100.0	100.0	100.0

The FRS is augmented with local authority statistics provided by the Department of Health, on the availability of childcare expressed as rates per 100 children within the local authority (109 local authorities referred to as LA from hereon)[24]. In this administrative data, the detailed provision of childcare by the type of provider was badly reported for some local authorities. Hence we drop those for which at least one type of provider was missing for each of the five years (nine local authorities were dropped). We also impute the provision when some years were missing by using the rate reported the following year (or the

[24] The variable combines three types of childcare: day nursery, playgroup, and childminder care.

previous year for 1997). The provision of care at the LA level ranges from 850 places per 10,000 children to more than 6,000 (City of London). City of London is a clear outlier since the second best LA only offers 3,800 places per 10,000 children.

We also compute the average price for formal care at the local authority level. This calculation is based on the price paid by mothers using childcare in the FRS; therefore this implicitly assumes that all mothers within the same local authority are faced with the same price[25]. This calculation constrains us to group nurseries, playgroups and crèche as the FRS does not distinguish between these categories of childcare providers. For each LA, we calculate the average price for all forms of formal care including nursery, playgroup, and childminder care[26]. This ignores heterogeneity within the local authority, however, this is a caveat that cannot be rectified with the FRS data. The model also includes local authority level information drawn from the Labour Force Surveys (LFS) of the respective years on female labour force participation and childcare worker characteristics.

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[25] Powell (2002) on the contrary imputes childcare prices for all individuals based on their own personal characteristics.

[26] Duncan and Giles (1996) report the hourly price of childcare for different types of providers. Even though the distributions are quite different, the hourly price of nursery and playgroup are comparable. In 1991, 90% of users of nursery and playgroup were paying less than a pound per hour, while the average price for childminder care was above £1.00.

Table 2.2: Sample derivation (FRS 1993/4-1997/8)

	Sample size	*% working*	*% using formal care*
All observations	56,341	63.2	23.3
Households with children	37,586	63.2	22.8
Married or co-habiting couples	20,622	70.6	25.4
Women	10,183	54.4	25.6
Households where partner works	9,228	60.1	26.7
Not in education/self-employment	9,197	57.7	26.2
Non-missing LA and other data	7,279	54.5	27.1
Final sample	7,279	54.5	27.1

The decomposition of the data to obtain our final sample is presented in Table 2.2 and the summary statistics on the variables of interest are presented in Table 2.3, separately for all mothers and then by working status. Table 2.2. also includes the mean for the labour force participation rate and the use of formal childcare to show that the selection of the sample does not significantly alter these variables of interest. The estimating sample includes married or cohabiting women with at least one pre-school age child[27].

[27] The usual school starting age in England is 5 years and the sample is selected in such a manner that only pre-school children are included.

Table 2.3: Summary statistics (FRS 1993/4-1997/8)

Variable	Mean	Std. Dev.
Use of formal childcare	0.458	0.498
LA price of formal care	2.282	0.361
LA care worker pay	4.062	0.297
LA care worker education	16.854	0.227
LA care worker tenure	4.621	0.736
LA proportion of four year olds in education	0.126	0.041
Mother: years of education	17.665	2.348
Mother: bad health	0.103	0.304
Mother: non-white	0.076	0.265
Mother: working	0.548	0.498
Father: years of education	17.706	2.709
Father: hours worked	4.457	1.018
Father: log income per week	6.042	0.561
One pre-school age child	0.510	0.365
Two pre-school age children	0.438	0.496
Three pre-school age children	0.052	0.222
Number of children	2.061	0.905
Age youngest child	1.516	1.333
LA proportion of women employed	0.687	0.071
LA proportion of pre-school children of all 0-16	0.307	0.026
LA proportion non-white	0.058	0.070
LA formal availability of childcare	2.765	0.894
LA proportion of free childcare	0.183	0.087
Number of observations	7,279	

Households, where neither parent works, are dropped from the sample because the childcare data in the FRS is asked consistently only from those households where at least one parent works (see Paull et al., 2002 for further discussion on routing effects in the FRS). Naturally this selection results in a sample that may not be nationally representative of all households with pre-school age children, however, until better data comes along this cannot be avoided. Information is collected on the type of childcare for each child and for

each child questions are asked about the total weekly hours of care and total weekly expenditure separately for term-time and holidays for each type of childcare. For households with more than one pre-school age child, we use the information on all the pre-school age children but weight the results by their frequency[28].

This selection procedure leaves us with a sample of 7,279 under school age children. The average mother in our sample left school at 17 and a half. About 10% of women self-report themselves as being in bad health and slightly over 7% are non-white. Half of the families have only one child less than five and only a marginal proportion has three or more children under the age of five. The presence of older children will also affect the use of childcare by the mothers by changing her utility of staying home. The father may also be able to provide some care or financial assistance to pay for childcare. More educated fathers as well as those working less hours can be expected to provide more childcare. The average price per hour of childcare in the local authority (deflated to 1998 prices) is slightly above £2 per hour for the two types of provider. These prices are consistent with those reported by the Daycare Trust (approximately £80 per week for full-time care).

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[28] As Table 2 shows, the sample is expanded in such way that every pre-school age child's information is used in the analysis, subsequently the mothers who are more than once in the sample because they have more than once kid are weighted by their frequency, for example, a mother with two pre-school aged children is in the data twice with both observations having the weight of ½. The estimates are corrected for this non-independence. On the contrary, Powell (2002) uses the childcare information only from the youngest child in the family

2.4 Results

Table 2.5 presents results for the queuing model in columns 1 to 6 (Model 2). The estimates of the demand equation in column 1 (marginal effect in column 3) of Table 2.5 reflect variation in mothers' preferences for formal childcare use. Similarly, the offer equation in column 4 (marginal effect in column 6) reflects variation in the propensity of childcare providers to pick certain individuals from the queue of potential customers.

However, we first estimate the constrained version of the model where there is no queue. This is equivalent to assuming that the supply of childcare is perfectly elastic and that a childcare place is always provided to a mother demanding childcare. This is a special case of the queue model, which is formally equivalent to imposing $\forall i, \Pr(O_i = 1 / D_i = 1) = \Pr(D_i = 1) = \Pr(USE_i = 1)$. This model can be estimated as a univariate probit for the use of formal childcare (Table 2.4).

The explanatory variables in both the queue model (Model 2) and the no queue model (Model 1) include variables summarised in Table 2.3 as well as dummies for year of survey and administrative region of residence[29].

[29] Omitted categories are 1994 and London, respectively, for year and region.

Table 2.4: Univariate probit estimates of demand for formal childcare (Model 1)

	Model 1 - No queue		
	Coefficient	*SE*	*Marginal effect*
LA price of formal care	0.480	0.317	0.187
LA price of formal care squared	-0.092	0.061	-0.036
LA care worker pay	-0.060	0.127	-0.023
LA care worker education	-0.179	0.167	-0.070
LA care worker tenure	0.023	0.059	0.009
LA proportion of four year olds in education	1.826 ***	0.549	0.720
Mother: years of education	0.047 ***	0.009	0.018
Mother: bad health	-0.070	0.061	-0.027
Mother: non-white	-0.116	0.074	-0.045
Mother: working	1.753 ***	0.040	0.602
Father: years of education	0.015 *	0.009	0.006
Father: hours worked	0.062 ***	0.020	0.024
Father: log income	-0.283	0.063	-0.111
Father: log income squared	0.027	0.029	0.010
Two pre-school age children	0.406 ***	0.049	0.159
Three or more pre-school age children	0.629 ***	0.103	0.246
Number of children aged less than 18	-0.143 ***	0.027	-0.056
Age of youngest child	0.235 ***	0.017	0.092
Observations		7,279	
Log Likelihood		-3480.439	

Note: Column 1 reports probit coefficients while column 3 reports marginal effects. Standard errors corrected for clustering at the region and year level. Model 1 is estimated using a univariate probit. Dummies for 8 administrative regions and 4 years were also included with London and 1994 respectively omitted. ***, ** and * refer to statistical significance at 1%, 5% and 10% level, respectively

With the no queue model specification, we can reject that the explanatory variables have no power; the log likelihood is –3480.4, which gives a likelihood ratio test of 2357, which is significantly higher than the critical value for a Chi-square with 30 degrees of freedom (43.77). Most of the expected relations hold. More educated households are more likely to use childcare. As an another potential caregiver, father's hours of work have a positive impact on the

likelihood of demanding formal care as expected. Surprisingly father's income does not affect the demand for formal care. Increase in the overall number of children below the age of 18 increases the preference for the mother to take care of her children herself. However, having two or more children aged less than four has a significant positive effect on the demand for childcare, which may reflect discounts for siblings in the formal childcare settings. As expected, the older the youngest child is, the more probable is the demand for childcare. The local authority level of formal childcare price is not a significant determinant of the use of childcare. The relatively large geographical grouping used in the analysis and the grouping of providers hides a lot of the real childcare price variation and hence this proxy for the price households face does not provide enough information. Ideally the analysis would be conducted on smaller geographical units for the price and quality of formal childcare variables, however, suitable data is not currently available. Also, none of the proxies for the quality of childcare, the hourly pay of childcare employees as well as their level of education and job tenure, are significantly different from zero. If parents have a preference for quality but are not able to observe it, they use price as an indicator of quality[30]. . This argument justifies the quadratic function in the price of childcare used in this analysis with demand increasing as the prices increases up to the level of £1.10, after which the demand becomes negatively affected by

[30] Mocan (2001) reveals moral hazard issues, with providers investing in the quality of easily to observe (by the parents) items rather than items directly related to the quality of the care provided. Blau (2001) also shows that parents are not good at assessing the quality of the childcare providers.

price. As expected mother's participation to the labour force is associated with a large increase in the probability of using formal childcare.

The queuing model (Model 2) estimates are presented in columns 1 to 6 of Table 2.5. Columns 1 to 3 in Table 2.5 report the estimates for the demand of childcare and columns 4 to 6 those for the offer of childcare services. The maximum log likelihood value is -3307, which compares favourably with the -3480 in the no-queue model. The likelihood ratio test computed from the sample log likelihood values is 347, while the critical values for a Chi-square with 30 degrees of freedom are 40.26, 43.77, and 50.89, respectively for 10%, 5%, and 1% levels of statistical significance, hence the no-queue model (Model 1) is rejected.

The estimates of the demand for childcare in Model 2 are similar to those obtained for the use of childcare in Model 1 with some additional significant relations. In the bivariate model, the local authority level of the price of childcare has a significant, non-linear effect on the demand for childcare with a maximum at £2.40 per hour, which compares favourably with the average figures provided by the Daycare Trust discussed in the previous section. Childcare providers charging a lower price than this probably appear to be of lower quality. Quite surprisingly, in this specification mother's years of education has a significant negative impact on the demand for formal childcare. All the characteristics of the household relating to the children are highly significant. An additional child reduces the probability of demanding childcare by three percentage points

whereas additional pre-school age children increases it due to economies of scale. A one-year increase in the age of the youngest child in the household increases the probability of demanding formal care by five percentage points, which is expected since the care of younger pre-school age children is more costly due to, for example, higher staff-child ratios. Father's earnings have a significant, negative impact on the demand for childcare with the maximum at £576.33 per week, after which an increase in paternal income increases the demand for childcare. This quadratic function supports the ideas that in less well off families, the mother has to rejoin the labour market and therefore demands childcare. This reflects the need to sustain the family income and thus the demand for childcare is reduced as the father's income increases. However, families where the father's earn more than £576 a week seems to have a preference for using childcare. This finding may reflect assortative mating. In the classic case of assortative mating, the men with a higher earnings potential marry women with similar potential for whom therefore the opportunity cost of staying home is high. As expected the demand for childcare is largely affected by the mother's participation to the labour force.

The childcare offer estimates are presented in the last three columns of Table 2.5 with the marginal effects in the last column. This equation is identified by the exclusion of the local authority price of childcare variables and the local authority level mean characteristics of the childcare workers. Furthermore, the offer equation includes local authority level variables for the supply of formal childcare

and free care as well as the proportions of women employed, non-white and pre-school age children, which all proxy for the demand for childcare services at the local authority level and thus the amount of competition faced.

Variables affecting the likelihood of an offer being made are mostly related to the characteristics of the children in the household. Older children are more likely to be accepted than babies, which could be related to regulations (Children Act 1989) increasing the number of staff for children under the age of two. Since childcare is a labour intensive activity, providers may have an incentive to focus on older children in order to maximise their profits. Interestingly, mother's years of education and father's hours of work have a positive impact on the likelihood of an offer being made. An offer of a childcare place is less likely to be made to non-white mothers although local authorities with a higher proportion of non-whites are associated with an increased likelihood of an offer being made.

It is not clear how providers allocate childcare; a needs basis rule is favoured by some, as the participation of the mother to the labour force is a clear indicator of the allocation of a place. If personal characteristics have no effect on the probability of receiving an offer, this would indicate a first come/first serve allocation model, additionally the error term in the offer equation and demand equations would be independent. The correlation between the two error terms is found to be non-significant; our estimate for *rho* in Model 2 has a chi-squared value with 1 degree of freedom of 2.589, which allows us to conclude that *rho* is not significantly different from zero.

Table 2.5: Partial observability bivariate probit model (Model 2)

	Model 2 – Queuing model					
	Demand			*Offer*		
	Coefficient	*SE*	*Marginal effect*	*Coefficient*	*SE*	*Marginal effect*
LA price of formal care	1.641 **	0.659	0.140			
LA price of formal care squared	-0.342 ***	0.127	-0.030			
LA care worker pay	0.127	0.308	0.011			
LA care worker education	-0.601	0.456	-0.052			
LA care worker tenure	0.035	0.140	0.003			
LA proportion of four year olds in education	0.717	1.593	0.062	1.719 **	0.741	0.640
Mother: years of education	-0.080 ***	0.026	-0.007	0.092 ***	0.013	0.034
Mother: bad health	-0.011	0.188	-0.001	-0.100	0.081	-0.038
Mother: non-white	0.260	0.239	0.019	-0.212 **	0.107	-0.081
Mother: working	3.863 ***	0.290	0.644	0.567 ***	0.127	0.211
Father: years of education/10	0.068	0.311	0.006	0.171	0.161	0.064
Father: hours worked/10	-0.106	0.049	-0.009	0.855 ***	0.029	0.319
Father: log income	-1.996 ***	0.655	-0.176	0.486	0.410	0.181
Father: log income squared	0.157 ***	0.050	0.014	-0.032	0.034	-0.012
Two pre-school age children	1.565 ***	0.224	0.140	0.023	0.099	0.008
Three pre-school age children	7.524 ***	0.253	0.088	-0.054	0.126	-0.020
Number of children	3.863 ***	0.290	0.031	-0.259 ***	0.032	-0.097
Age youngest child	0.595 ***	0.083	0.051	0.110 ***	0.034	0.041

Table 2.5 continued

	Model 2 – Queuing model					
	Demand			*Offer*		
	Coefficient	*SE*	*Marginal effect*	*Coefficient*	*SE*	*Marginal effect*
LA proportion of women employed				0.617 *	0.356	0.230
LA proportion of pre-school children of all 0-16				0.198	1.078	0.074
LA proportion non-white				1.047 **	0.474	0.390
LA formal availability of childcare				-0.007	0.026	-0.003
LA proportion of free childcare				0.120	0.260	0.045
Observations				7,279		
Rho				-0.281		
Log Likelihood				-3306.9383		

Note: Marginal effects reported. Standard errors corrected for clustering. Model 2 is estimated using a partial observability model. Dummies for 9 administrative regions and 4 years were also included.
***, ** and * refer to statistical significance at 1%, 5% and 10% level, respectively.

The demand and offer equations of Model 2 allow us to calculate the proportion of mothers asking for childcare and the size of the queue for childcare (Table 2.6)[31].

Table 2.6: Predicted probabilities in the use of childcare

Pr (D=1)	0.707
Pr (O=1/D=1)	0.567
*Pr(O=0/D=1) *Pr(D=1)*	30.6

Table 2.6 reports the predicted probabilities from the partial observability model (Model 2). For our sample, 70.7% of mothers of pre-school age children would like to use formal childcare, however, only 56.7% of these demands are accepted. This implies that the excess demand for childcare is 30.6% for the total population. Furthermore, for the mothers of pre-school age children who want formal childcare the queue is 43%.

The shortage of childcare in the UK is thus rather large. The model does a good job at predicting the use of childcare with 80% of the use of childcare correctly predicted (see Table 2.7).

Additionally, the size of the queue is nearly similar to the proportion of mothers using informal childcare (see Table 2.1).

[31] The probabilities are estimated for each individual. The mean probability for the population is thereafter calculated.

In the next section, we explore this issue of whether the informal sector accommodates for the unsatisfied demand for formal childcare. If this is the case, a policy increasing the supply of formal care may only shift users from informal to formal childcare and thus be unlikely to have large effects on the labour supply of mothers[32].

2.5 Simulations and policy recommendations

If informal care only caters for mothers who have been rejected from formal childcare then policies aiming at increasing the use of formal childcare (usually in order to increase female labour supply) would mostly shift children from one type of care to another and hence are likely to have no substantial effect on the female labour supply. If, on the other hand, the queue is mostly composed of women who are taking care of their children themselves, then a policy of increasing the supply of formal care would free these mothers from part of their parental care duties and may allow them to participate in the labour force.

In Table 2.7, we report the actual and predicted use of care[33]. The model predicts rather accurately the type of childcare used. For example, whilst 46% of individuals use formal childcare the model correctly predicts 87% of them (39.88/45.84). Out of the mothers predicting to be queuing for childcare, 42%

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[32] A policy of shifting from informal to formal sector may be desirable, even if no effect on the labour supply of mother is expected, if the quality of the care provided is higher in the formal sector. The relative quality of the two sectors is difficult to judge. Relatives may be full of good intentions but does that make them good carers, on the other hand, formal care may be less good than the one provided by the experienced neighbour.

[33] Individuals with a predicted probability greater than 0.5 were coded as 1.

rely on informal care and 30% use parental care. So it appears that a majority of mothers queuing for childcare are using informal care as a substitute, thus a policy increasing the supply of formal care may not have a large impact on the labour force participation of women, but mostly shift children from informal care to formal care. Formal and informal care are close substitutes.

Table 2.7: Origin of mothers queuing for childcare

	Observed		
Predicted	*Informal care*	*Formal care*	*Row total*
Not demanding	2,101 [28.86]	156 [2.14]	2,257 [31.01]
Queuing	687 [9.44]	278 [3.82]	965 [13.26]
Using care	1,154 [15.85]	2,903 [39.88]	4,057 [55.74]
Column total	3,942 [54.16]	3,337 [45.84]	7,279 [100.00]

The traditional complaints about childcare in the UK concern the scarcity of the supply of childcare and its high cost. We simulate the effects of changing these characteristics on the demand and the queue for childcare. Since we have used variations in prices and supply to identify respectively the demand equation and the offer equation, simulated policies have to affect both prices and supply in order to affect both equations. Additionally, family characteristics are important, especially mother's labour force participation and paternal income. We simulate five policies along these lines, the effects of which on the demand and the queue for childcare are reported in Table 2.8.

Table 2.8: Effects on demand and queue for childcare (full sample)

	Baseline	*Policy1*	*Policy2*	*Policy3*	*Policy4*	*Policy5*
Pr(D=1)	0.707	0.706	0.981	0.719	0.708	0.707
Pr(O=1/D=1)	0.567	0.527	0.614	0.526	0.525	0.526
*Pr(O=0/D=1)*Pr(D=1)*	0.306	0.334	0.379	0.341	0.336	0.335

Notes: Policy1: Father's weekly pay increased by 10%
Policy2: All mothers working
Policy3: Mean formal childcare price at LA level increased by 10%
Policy4: LA proportion of children in education increased by 10%
Policy5: LA proportion of free childcare use increased by 10%

Overall, the simulated effects seem quite small. Increasing the proportion of free childcare or care provided within schools, do not reduce the queue for formal childcare. We cannot comment on the relative efficiency of one policy versus another one, since the interventions simulated here are not in the same metric and the cost of each policy is undetermined.

2.6 Conclusion

We have examined the determinants of childcare demand in the UK for mothers of pre-school age children. For the first time in this type of analysis, we account for partial observability: a woman uses childcare if she demands it and if her offer is accepted. We found an excess demand for childcare in the UK. The size of the queue for childcare is substantial: while a bit more than 70% of mothers would like to use childcare, only 57% are provided with a place for their child.

This research supports the claim that there is some market failures in the childcare market with supply appearing rather inelastic. It is unclear why this

estimated excess demand does not lead to an increase in the supply of childcare. Market failures also suggest that some governmental intervention is needed either to provide alternative for of childcare or to help private providers joining the market.

CHAPTER THREE: COST OF CHILDCARE AND FEMALE EMPLOYMENT IN ENGLAND

3.1 Introduction

Current government policy in the UK emphasises the importance of work, instead of welfare payments, as the main source of income. A key strategy is to increase the employment rate among families with children, for example, to reduce child poverty (see, Gregg and Harkness, 2003 for evidence of these reforms for lone parents' employment rates). The decision of mothers of pre-school age children to become employed usually implies the need to arrange formal childcare. The labour force participation of mothers of young children, however, may exhibit sensitivity to the cost, the quality, or the availability of childcare.

This chapter provides UK evidence on the role that childcare costs play in the decision of mothers of pre-school age children to participate in the labour market[34]. The cost of childcare can be an important factor influencing the decision to enter the labour force. According to the Daycare Trust, the typical cost of a nursery place is more than the average household spends a year on either food or housing (Daycare Trust, 2001)[35]. It is therefore reasonable for

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[34] Contrary to the previous chapter, where the price of childcare was that faced by the inhabitants of a given local authority, in this chapter the price is the actual price paid by the household for formal childcare.

[35] The figures calculated for the cost of a nursery place for a two-year old child is £134 a week (£168 a week in London) in 2004. This compares to an average household income of £562 a week and the average weekly expenditure on housing and food combined of £82 per week.

mothers with low potential earnings to stay at home and not purchase formal childcare.

In this chapter the decision to become employed is jointly modelled with the decision to use formal, paid childcare, both of which are influenced by the conventional determinants such as the price of the available childcare and the expected wage of the mother.

The empirical results of this chapter can contribute to the childcare public policy debate. For instance, increases in the government expenditure on childcare subsidies are often argued on the basis of increasing the labour force participation of mothers of young children (Inland Revenue, 2001). These arguments, however, are based on certain assumptions about the responsiveness of labour force participation with respect to the policy instruments.

Data are drawn from the 1993/4-1997/8 Family Resources Survey and data on the regional availability of childcare from the Department of Health. The estimation sample is composed of 7,096 married women with a pre-school age child. The use of formal childcare is a binary variable taking the value of 1 when the child is reported to be using childminder, nursery, playgroup or crèche care and the payment for this care is positive. Appropriate sample selection corrections are applied to the analysis to obtain consistent estimates for the wages and the price of childcare for the whole sample.

Baseline simulations, 50.7% for labour force participation and 28.1% for the use of childcare, come very close to replicating the observed participation and use of formal childcare rates (50.5% and 27.4%, respectively). The simulation results show that if there were a universal zero-cost childcare available to the mothers in this sample the model predicts that 76.1% would be employed while only 44.8% would be using formal childcare. Almost a third of the mothers are hence predicted to use informal care when they work even if childcare were provided free of charge.

Previous studies of interest have studied the impact of the price of childcare on many issues of public policy interest, for example, on the use of formal, paid care, on employment participation, on the type of care[36], or on the quality of care[37]. This chapter concentrates on the first two behavioural responses that is the use of formal childcare decision and the labour force participation decision.

The Prime Minister Tony Blair, quoted in the introduction to this thesis, identified three areas of concern on childcare policy: quality, accessibility, and affordability. This paper concentrates on the affordability of childcare by looking at the importance of childcare costs for the joint employment and use of childcare decisions. This study focuses on women only since they are the primary childcare providers in the majority of families.

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[36] See, for example, Hotz and Kilburn (1991), Hofferth and Wissoker (1992), Blau and Hagy (1998), Michalopoulos and Robins (1999).
[37] See, for example, Berger and Black (1992), Michalopoulos et al. (1992), Hagy (1998) and Blau and Hagy (1998).

Section 1.4 reviews the previous literature on the impact of the price of childcare on the use of formal modes of care and labour force participation of mothers. Furthermore, Appendix 3 summarises the previous elasticity estimates with details by country and method of estimation. The following section presents the economic and econometric model, while section 3.4 describes the data used in the empirical analysis. Section 3.5 contains the results of the employment and the use of childcare regressions as well as the policy simulations and section 3.6 concludes with a brief policy discussion.

3.2 Theoretical and econometric model

This chapter implements an empirical choice model to examine the joint employment and childcare choice decisions of married mothers of pre-school age children. The basic theoretical model underlying this analysis is discussed in section 1.2. To summarize the model, the decision to participate in the labour force is affected by the conventional determinants such as the wages and the non-labour income, but also by the cost of childcare. On the other hand, the decision to use formal childcare is influenced by the price of childcare, but also by the expected wage of the mother.

The decision regarding the use of childcare involves the choice between formal, paid childcare and informal childcare at zero cost. This chapter focuses on these two aggregate modes due to data limitations. Formal modes of childcare

include nurseries, childminders, playgroups and crèche. Informal modes of care include the care by the members of the immediate family and other relatives.

The econometric method is similar to those adopted in most of the previous empirical research referred to in Appendix 3. The method simultaneously estimates the probability of labour force participation and the use of formal childcare including selectivity corrected price of childcare and wage estimates. Unlike in the previous chapter, which used aggregated price of childcare data, this chapter uses the actual price paid by the family for their use of formal modes of childcare.

The estimating equations are bivariate probits on the probability of labour force participation (*LFP*) and the probability of purchasing formal childcare (*USE*). This analysis uses the following definition of formal childcare: *USE* is a binary variable taking the value of 1 when the child is reported to be using childminder, nursery, playgroup or crèche care and the payment for this care is positive[38]. Because the wages are not observed for those who do not engage in employment and the price of childcare is not observed for those who do not use formal childcare, the estimation requires probit and bivariate probit sample selection for the wage and the price of childcare, respectively. The identifying restrictions for these models are discussed in more detail in sections 3.3 and 3.4.

[38] In this analysis the different modes of childcare are not taken into account since the distinction between the different types of care is not accurate enough in the data.

The sample selection on the price of childcare relies on a bivariate probit because the selection is the result of two decisions: the use of paid care decision and the labour force participation decision. Hence the estimation accounts for the possibility that women who work may have had access to lower cost childcare. The formal childcare price equation therefore involves two selection terms, one for the probability of being a wage earner and one for the probability of purchasing market childcare. In the previous UK studies, the simultaneity of the work and the use of childcare decisions is only accounted for in the study by Jenkins and Symons (2001) for a sample of lone mothers.

Specifically,

$$L = \alpha_L + \beta_L X_L + \chi_L W + \delta_L P + \varepsilon_L \qquad (3.1)$$

$$C = \alpha_C + \beta_C X_C + \chi_C W + \delta_C P + \varepsilon_C \qquad (3.2)$$

where

L = coded 1 if the mother engages in paid employment, zero otherwise

X_L = a vector of determinants of the decision to become employed (for example, age, family composition, husband's income)

W = the expected hourly wage of the mother

P = the expected price of childcare

C = coded 1 if mother purchases formal childcare, zero otherwise

X_C = a vector of determinants of the decision to purchase formal childcare (for example, availability of alternative care arrangements such as older children or grandparents, education of mother and father, and ethnic origin of mother)

ε_L; ε_C = error terms that are distributed bivariate normal with mean 0, variance 1, and a non-zero covariance ρ

The estimated parameter vectors are α, β, χ, and δ. The subscripts L and C denote the employment and the use of childcare equation, respectively. The expected wage W and the expected price of childcare P are entered as two distinct terms because the total hours worked per week is not constrained to be equal to the number of hours in paid childcare[39]. In other words, the estimation allows mothers to purchase more or less hours of childcare than their working hours and even using childcare when they are not working.

An alternative model to formalise the decision process between the use of childcare and female labour force participation includes, for example, a two-stage estimator by Mallar (1977), which is extensively discussed in Maddala (1983)[40]. The benefit of the Mallar model is that it includes the direct influence or propensity of one variable upon the other and *vice versa*. However, this chapter

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[39] Averett et al (1997) uses a single regressor (hourly wage minus hourly price of childcare), however, this application may be misleading if the hours of childcare use do not equal hours worked.

[40] This alternative method of estimation was brought to my attention by Alan Duncan.

uses the type of modelling most common in the previous childcare literature to allow more direct comparison across different studies.

The key parameters of interest in equations (3.1) and (3.2) are the coefficients of the predicted wage and price of childcare. Calculation of the price of childcare and the own wage elasticities with respect to *LFP* and *USE* drives the discussion of the policy effectiveness of subsidising childcare costs. For example, the childcare price elasticity of labour force participation gives the responsiveness of the labour force participation to a change in the price of childcare.

Before estimating equations (3.1) and (3.2) described above, we must estimate the selection equations. As noted earlier, the wages are only observed for mothers who work and the price of childcare for mothers who use formal childcare. Hence we need to estimate the price of childcare for non-users and the wages for non-workers. Working women and women using childcare have different unobservable characteristics than non-working women and those not using formal childcare, hence a selection problem occurs. The selection-correction required for the price of childcare, however, is more complicated since it involves two simultaneous decisions (*LFP* and *USE*) that are not independent from each other. The econometric method uses an extension of the Roy model, which allows double-selection (see, for example, Maddala, 1983 for the derivation of the selection correction or Tunali, 1986 for related identification issues).

First, since wages are only observed for those who participate in the labour market, we need to estimate a wage equation, which allows me to produce a wage measure for all women in the sample. Using the wages from the sub-sample of wage earners may result in biased estimates for wages of the non-working mothers since the working mothers of pre-school age children may possess some unobservable characteristics (such as motivation) that increase their likelihood of working. Hence a sample-correction model is used to obtain correct parameters, which allows the calculation of the expected wage for the whole sample. We construct a wage for all women in the sample using the standard techniques to correct for possible selectivity bias (Heckman, 1979). The wage equation is estimated for a sub-sample of wage earners and a linear prediction yields the selectivity corrected, expected hourly wage, $\hat{W}$, for the whole sample. The sample selection model corrects for the fact that the reservation wage is less than the offered wage for women who work. The wage equation is specified as follows and it follows the standard labour economic practice in estimating wage equations:

$$OW = \phi_{OW} X_{OW} + u_{OW} \qquad (3.3)$$

where

OW = the log hourly wage of the mother for the sub-sample of wage earners

X_{OW} = a vector of determinants of the hourly wage of the mother (for example, age, level of education, region, and previous work experience)

u_{OW} = standard normal error term with mean *0* and variance σ^2

Both the age and the level of education of the mother are expected to increase wages. The number of children in the household is used as a proxy for intermittent work history and is expected to have a negative impact on wages[41]. The selection model for labour force participation is identified with variables that affect the mother's reservation wages and hence the participation decision, for example partner's income, but that are not correlated with the wage.

Second, the expected price of childcare is based on parameter estimates from a sub-sample of mothers who purchase formal childcare. Selectivity bias may exist if the mothers who use childcare had easier access to childcare at lower prices, which might have influenced their decision to work and to use formal childcare. Hence we estimate the price of formal childcare equation to produce a price estimate for all mothers in the sample. In other words, we need price of childcare estimates for those mothers not using formal childcare, and for those using zero-cost childcare. The price of childcare equation is estimated as follows and it includes two selectivity correction terms, one for the probability of being employed and another for the probability of using formal childcare. The correction for the probability of being employed is necessary since these mothers' entry into the labour force may be influenced by them finding unusually low priced childcare and they may not be available to the random potential

[41] Michalopoulos and Robins (2000), Powell (2002), and Connelly and Kimmel (2000) also use the number of children in the household in the wage equation to proxy intermittent work history.

participant[42]. First we estimate a bivariate probit for *LFP* and *USE*. The appropriate sample selection correction for the childcare cost equation is more complicated than that of the wage equation because the selection is the result of two decisions, *LFP* and *USE*, and the correlation ρ between these two decisions. The two Inverse Mills ratios are then included as regressors in the price of formal childcare regression. The selectivity corrected parameter estimates allow the prediction of the expected price of childcare for the whole sample. The price of childcare equation is estimated as follows:

$$OP = \phi_{OP} X_{OP} + u_{OP} \tag{3.4}$$

where

OP = the hourly price of childcare for the sub-sample of users of formal, paid childcare

X_{OP} = a vector of determinants of the hourly price of childcare (for example, the age of the pre-school child, the presence of additional children, unearned income, and regional characteristics)

u_{OP} = standard normal error term with mean *0* and variance σ^2

The price of childcare is defined as the hourly price of childcare per hour of care used by the pre-school age child. The assumption in estimating the childcare

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[42] For example, HSBC banking group have introduced a workplace crèche to attract female employees.

prices is that the price varies according to a set of family characteristics, and regional characteristics. The labour force participation decision is identified with the same variables as when estimating the wage equation. The use of childcare is identified with variables that are correlated with the decision to use formal childcare but that do not affect the price paid for it. This may include, for example, variables that proxy the extent of the local network which is positively correlated with the probability of using informal childcare.

Let us recap the procedure taken to estimate the supporting equations. First, a reduced-form probit (*LFP*) is estimated to create a selection term (Inverse Mills ratio) to correct for sample selection bias in the wage equation. Next, a reduced-form bivariate probit (*LFP* and *USE*) is estimated in order to produce selection correction terms for the price of childcare equation. Finally, the wage and the price of childcare equations are estimated by OLS with the appropriate corrections for their respective selection biases. After the wage and price of childcare equations have been estimated, both the predicted wage and the price of childcare estimates are included in the simultaneously determined *LFP* and *USE* equations.

The following section describes the data used in the analysis and applies the method described herein to analyse the effects of the price of childcare on women's labour force participation and the use of formal childcare in England.

3.3 Description of the data

The empirical analysis is conducted using five waves of the Family Resources Survey (FRS). These data cover the fiscal years 1993/4-1997/8[43]. The FRS is an annual cross-section survey of around 26,000 British households each year, which is supported by the Department of Social Security (currently knows as the Department for Work and Pensions) for policy monitoring and evaluation as well as benefit expenditure forecasting. The benefits of using the FRS include large sample sizes and inclusion of detailed questions relating to the labour market activity and childcare usage and other characteristics of the family as well as benefits and childcare take-up and expenditure. Appendix 6 includes detailed information on the FRS.

The FRS is augmented with local authority (LA) level data on the availability of different types of childcare provided by the Department of Health. The childcare availability data is reported as the situation in the local authority on March 31st of each year; for example, 31.3.1994 data on the availability of childcare is merged into the 1993-94 fiscal year FRS. The local authority level data is used to form two variables *supply1* and *supply2*. *Supply1* gives the combined number of day nursery and playgroup places available for children

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[43] More recent years of the FRS are available for analysis, however, they have not been included in this study due to the constraint that the local authority childcare information is not available for years beyond 1998.

under 5 expressed as a rate per 100 children under 5[44]. *Supply2* reports the number of places with childminders expressed as a rate per 100 children under 5[45]. In the case that the childcare availability figures are missing for all the years, the local authority is dropped from the analysis. However, if the information is missing for one year, the observation is imputed by taking an average of the previous and the following years when possible.

Table 3.1: Sample derivation (FRS 1993/4-1997/8)

	Sample size	*% working*	*% in formal care*
All observations	56,341	63.2	23.3
Households with children	30,701	63.2	22.8
Married/co-habiting couples	20,614	70.6	25.4
Women	10,181	54.4	25.6
Households where partner works	9,227	60.1	26.7
Not in self-employment or education	8,629	57.7	26.2
Missing LA and other data	7,096	54.5	27.1
Final sample	7,096	54.5	27.1

Table 3.1 reports the means of achieving the sample of women used in the analysis. Table 3.1 also includes the mean for the labour force participation rate and the use of formal childcare to show that the selection of the sample does not alter these variables of interest. The estimating sample includes married or cohabiting women with at least one pre-school age child[46]. Households, where neither parent works, are dropped from the sample because the childcare data in

[44] The figures come from a table titled "Day care places available for children under 5 at 31 March, by type of provision" giving rates per 10,000 population aged under 5 for the day nursery and playgroup places in the Department of Health publications.
[45] The variable combines two variables from the Department of Health publications that are separated by the age group for which the childminder was registered: 1) full age range but using number of places for under 5's only and 2) specific age registered for under 5's only.
[46] The usual school starting age in England is 5 years.

the FRS is asked consistently only from those households where at least one parent works[47]. Information is collected on the type of childcare for each child and for each child questions are asked about the total weekly hours of care and total weekly expenditure separately for term-time and holidays for each type of childcare. For households with more than one pre-school age child, we use the information on all the pre-school age children but weight the results by their frequency[48].

Since the focus of the analysis is the joint employment/use of childcare decision of mothers of pre-school age children, the analysis is limited to families where this choice is feasible; hence the mothers who are self-employed or in full-time education are excluded from the sample. Finally, the local authority level data on the availability of childcare places and the proportion of fee-free childcare available within the local authority are missing for 414 observations and hence these are excluded from the analysis. This yields a frequency-weighted sample of 7,096 mothers. Of these 7,096 mothers, 3,865 or 54.5% are employed. Of this sample, 1,921 or 27.1% report using formal, paid childcare (see Table 3.2). These figures are similar to those found in the Repeat Study of Parents' Demand for Childcare, which reports that less than half of working mothers had used some formal childcare in the past year (Woodland et al., 2002). They report that three-

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[47] This is also the reason for single mothers not being included in the analysis.

[48] As Table 2 shows, the sample is expanded in such way that every pre-school age child's information is used in the analysis, subsequently the mothers who are more than once in the sample because they have more than once kid are weighted by their frequency, for example, a mother with two pre-school aged children is in the data twice with both observations having the weight of ½. On the contrary, Powell (2002) uses the childcare information only from the youngest child in the family

quarters of all families (including lone mothers and non-working households) used informal childcare in the year prior to the survey, most commonly care provided by the grandparents

Table 3.2: Work and use of childcare outcomes (FRS 1993/4-1997/8)

		Use of formal care		
		0	*1*	*Total*
Work	*0*	**2,823** (87.4) [54.6]	**408** (12.6) [21.2]	**3,231** (100.0) [45.5]
	1	**2,352** (60.9) [45.5]	**1,513** (39.2) [78.8]	**3,865** (100.0) [54.5]
	Total	**5,175** (72.9) [100.0]	**1,921** (27.1) [100.0]	**10,668** (100.0) [100.0]

Note: Number of observations in **bold**, row percentages in parenthesis, column percentages in square brackets.

Summary statistics, separately for the users and non-users of formal childcare, for the key variables of interest are provided in Table 3.3.

Table 3.3: Summary statistics (FRS 1993/4-1997/8)

	Formal care used		*No formal care used*	
	Mean	*SE*	*Mean*	*SE*
Individual and household characteristics				
Age	32.602	4.328	30.790	4.792
Mother's school-leaving age, ≤ 16 years	0.347	0.476	0.503	0.500
Mother's school-leaving age, 17-18 years	0.340	0.474	0.285	0.452
Mother's school-leaving age, 19-20 years	0.170	0.376	0.126	0.331
Mother's school-leaving age, ≥ 21 years	0.144	0.351	0.087	0.281
Non white	0.061	0.239	0.093	0.291
Works	0.727	0.445	0.421	0.494
Alternative caregiver: females 13-17 (number of)	0.021	0.182	0.027	0.185
Alternative caregiver: males 13-17 (number of)	0.027	0.176	0.018	0.144
Alternative caregiver: adults (binary)	0.030	0.170	0.047	0.211
Child variables				
Age of pre-school child	2.458	1.442	1.837	1.374
One pre-school child	0.535	0.478	0.561	0.484
Two pre-school children	0.410	0.478	0.387	0.484
Three pre-school children	0.055	0.309	0.052	0.309
Number of children aged 5-12	0.384	0.651	0.465	0.732
Number of children aged 12-16	0.046	0.256	0.040	0.227
Income variables				
Log wages	2.124	0.497	1.861	0.513
Predicted wage	1.609	0.360	1.443	0.365
Father's pay, £/week	498.129	459.707	459.022	368.732

Table 3.3 continued

	Formal care used		*No formal care used*	
	Mean	*SE*	*Mean*	*SE*
Regional variables				
North	0.030	0.171	0.029	0.168
Northwest	0.127	0.333	0.104	0.306
Yorkshire & Humberside	0.090	0.287	0.085	0.278
East Midlands	0.080	0.272	0.083	0.275
West Midlands	0.123	0.328	0.115	0.319
East Anglia	0.044	0.205	0.065	0.247
Greater London	0.112	0.315	0.119	0.324
Southeast	0.303	0.459	0.293	0.455
Southwest	0.091	0.288	0.107	0.309
Childcare variables				
Actual price of childcare, £/hour	0.952	1.149	*n/a*	*n/a*
Predicted price of childcare, £/hour	1.899	0.406	1.824	0.424
Proportion of fee-free childcare used in LA	0.018	0.008	0.018	0.009
LA provision of nursery and playgroup care, places/100	19.853	6.385	19.686	6.345
LA provision of childminder care, places/100	7.816	5.568	7.806	5.218
Observations	1,921		5,175	

The childcare users and non-users differ especially in the schooling level of the mother. The customers of formal childcare are in general better educated with 14.4% (versus 8.7% for non-users of childcare) of the sample having left education in their 20's. Also, the proportions of those leaving school at the minimum school-leaving age are 34.7% for users and 50.3% for non-users. The mothers using formal childcare are also slightly older and a larger proportion of them are white, in comparison to the non-users of childcare.

The income differences between the two groups of women are highly different. Both own and partner's income are higher for the group of women who use formal childcare. Regional variation between the users and non-users of formal childcare is virtually non-existent. The childminder provision of care is slightly higher within the group of mother's who use formal childcare, however, it is not possible to comment on cause and effect[49]. This would suggest that the number of childcare places demanded cannot be explained by the number of places supplied at the regional level. However, since the impact may vary by individual characteristics, the local authority childcare availability variables are not dropped from the analysis.

Variables used in the analysis include a set of demographic characteristics of the mother, a set of household composition variables and a set of structural variables designed to capture differences in the labour market and the childcare

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[49] However, childminding is commonly considered to be more flexible and affordable than other types of formal childcare (see Appendix 1 for more information on the different types of care).

market. The variables capturing the demographic characteristics of the mother include her age, her educational level, dummy for non-white[50], her and her husband's non-labour income and her husband's wage income. The set of household composition variables includes the number of children (1, 2, or 3 pre-school age children), or the presence of children of various ages (5-12 and 13-16) as well as the presence of other adults living in the household. The set of structural variables include the local authority availability of childcare, the proportion of free care used within a local authority, and the length of current residence. The length of residence is constructed as a binary variable, which is 1 if the household has moved within the past two years prior to being surveyed. This variable acts as a proxy for the availability of local informal carers. Low or zero-cost informal care, e.g. by relatives, neighbours, and older children in the household, leads to lower reservation wages and hence to a higher participation probability. Ribar (1992) finds that the cross-price effects of market care and non-market care are positive indicating that paid and unpaid childcare modes are substitutes in the US childcare markets. This finding is contrary to our finding for the UK that was presented in Chapter 2.

The average weekly payment for childcare for married couples was £40.56 per child in 1994 conditional on reporting a positive payment[51]. In general those

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[50] The non-white group includes the following categories: black (Caribbean), black (African), black (undefined), Indian, Pakistani, Bangladeshi, Chinese, and other undefined.

[51] Note that Finlayson et al. (1996) truncate hourly childcare price data at £10 at the top and £0.25 in the bottom as well as at £120 per weekly data.

with more children did not pay more for childcare per week (Finlayson et al., 1996).

The expected price of childcare is defined as the full hourly price of care that parents should anticipate to pay. Prices paid by users of childcare are used to attribute prices to non-users of childcare as explained in the previous section. The income variables are excluded from the childcare price regressions since the positive correlation between income and price of childcare may be due to the choice of higher quality childcare arrangements. The price of childcare is expressed in £ per hour. Positive childcare expenditures are in some cases reported for those using informal care (28 observations), however, prices are used for those using formal childcare only. Since the hours of childcare and the payment made for it are recorded as a sum over all types, the hours and expenditure data are not used for children who use a mixture of formal and informal care. However, the fact that they use formal childcare is used in the analysis to avoid further sample selection problems.

Identifying variables in the previous research that is summarised in Appendix 3 consist mostly of state level variables that proxy the quality of childcare, for example, maximum child-staff ratio, the level of training of centre based childcare providers, and mean wage of childcare workers (see, for example, Kimmel, 1998). This chapter uses local authority level data on the average wages, years of education and work tenure of childcare workers to identify the

childcare prices[52]. Furthermore, Powell (2002) uses regional per capita income to identify childcare prices. As argued in Chaplin et al. (1999), this variable is expected to affect the wages of childcare workers but not the demand for childcare. We have constructed a similar variable using the household income information from the FRS.

3.4 Results

Subsection 3.4.1 discusses the results from the supporting equations presented in Table 3.4 and Table 3.5. The results from the employment-childcare use model are presented in subsection 3.4.2 in Table 3.6 and Table 3.7.

3.4.1 Results from the Supporting Equations

In this section we present the results from the supporting equations that are used to predict the wages (Table 3.4) and the price of childcare (Table 3.5) for the whole sample.

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[52] These variables are constructed from the Labour Force Surveys separately for each year.

Table 3.4: Sample-selection corrected wage estimates

	Selection probit work		*Hourly log wage*	
	Coefficient	*SE*	*Coefficient*	*SE*
Age	0.240 ***	0.025	0.148 ***	0.016
Age²/10	-0.031 ***	0.004	-0.017 ***	0.002
Years of education	0.123 ***	0.035	0.092 ***	0.003
Non white	-0.114 **	0.050	-0.190 ***	0.031
Age of pre-school age child	0.037 ***	0.007		
Two pre-school children	-0.445 ***	0.028	-0.149 ***	0.017
Three pre-school children	-0.499 ***	0.045	-0.227 ***	0.031
Number of children aged 5-12	-0.292 ***	0.020	-0.173 ***	0.013
Number of children aged 12-16	-0.261 ***	0.059	-0.181 ***	0.036
Father's pay, £/week/100	-0.056 ***	0.004		
Father's non-work income, £/week/10	-0.007 ***	0.002		
Mother's non-work income, £/week/10	0.009 ***	0.002		
Lambda			0.509 ***	0.016
Constant	-4.020 ***	0.400	-2.789 ***	0.261
Observations	7,096, of which 3,581 censored			
Log likelihood	-9503.617			
ρ	0.869 ***			

Note: Specifications include year dummies, regional dummies, and dummies for missing bad health, region and qualification variables.
*, **, and *** denote significance at 10%, 5%, and 1% level respectively.

Table 3.4 presents a selectivity-corrected wage model for the mother, where the selection concerns the decision to become employed and hence being in the sub-sample of wage-earners. The self-employed and students are not included in any of the estimation. The results are generally consistent with theoretical expectations. The probability of participating in the labour force increases with age but at a decreasing rate[53]. Schooling has the expected effect on both participation and wages. Compared to women who left school at the earliest

[53] As has become standard practice for early stages of estimation, second-order age terms are included while they are excluded in the structural models (see Mroz, 1987).

opportunity, those with more schooling are more likely to be employed. The non-white ethnic origin is associated with both lower participation and 20% lower wages than the comparison woman. The presence of children of any age is associated with decreased participation with the effect being the strongest for the number of pre-school age children. The variables used to identify the model are commonly used in previous studies, for example, Cleveland et al. (1996) and Kimmel (1998). These variables (partner's pay, non-labour income) have a direct effect on the reservation wages of mothers hence affecting her employment decision with no impact on the wage. The partner's work and non-work income have the expected negative effect on the employment probability, however, mother's own non-work income is positive and significant. This unexpected result may be explained by this income being mainly income from, for example, investments and savings. The identifying variables are tested using an informal method suggested by Cameron and Taber (2000), which examines the relationship between the excluded variables and the observables in the wage or the price equation. The results suggest that the identifying variables are working in the manner that is expected of a valid identifying variable[54]. The positive and significant selection correction term (lambda) means that the wage earners in the dataset have unusually high wages owing to their unobservable characteristics (such as motivation) compared to women with similar characteristics who are not in the labour force.

[54] These results are available from the author upon request.

Table 3.5: Bivariate probit selection-corrected price of childcare estimates

	Working		*Use of formal care*		*Price of formal care*	
	Probit coefficient	*SE*	*Probit coefficient*	*SE*	*OLS coefficient*	*SE*
Age	0.243 ***	0.025	0.236 ***	0.030	0.096	0.074
Age²/10	-0.033 ***	0.004	-0.030 ***	0.005	-0.001	0.001
Mother's school-leaving age, 17-18 years	0.207 ***	0.030	0.274 ***	0.032		
Mother's school-leaving age, 19-20 years	0.137 ***	0.040	0.307 ***	0.042		
Mother's school-leaving age, ≥ 21 years	0.101 **	0.047	0.359 ***	0.048		
Years of schooling					0.071 ***	0.009
Non white	-0.191 ***	0.050	-0.232 ***	0.056	-0.231 *	0.122
Age of pre-school child	0.036 ***	0.009	0.203 ***	0.010	0.005	0.059
Two pre-school children	-0.505 ***	0.028	0.027	0.030	-0.156 ***	0.057
Three pre-school children	-0.540 ***	0.044	0.030	0.045	-0.439 ***	0.092
Number of children aged 5-12	-0.304 ***	0.020	-0.196 ***	0.021	0.083	0.054
Number of children aged 12-16	-0.169 ***	0.058	0.563 **	0.220	0.417 *	0.234
Working part-time			-0.632 ***	0.039		
Adults dummy			-0.260 ***	0.073	-0.423 ***	0.157
Females aged 13-17			-0.566 ***	0.209	-0.323	0.224
Males aged 13-17			-0.373 *	0.223	-0.183	0.237
LA nursery and playgroup care, places/1000			-0.013	0.009	0.001	0.014
*Supply*household income/100*			0.002	0.001	-0.001	0.002
LA childminder care, places/1000			0.024 *	0.013	-0.039 *	0.023
*Supply2*household income/100*			-0.004 *	0.002	0.006	0.004
LA childcare avg. wage					0.343 **	0.140
LA childcare avg. education					0.073	0.171
LA childcare avg. experience					0.100 *	0.061

Table 3.5 continued

	Working		*Use of formal care*		*Price of formal care*	
	Probit coefficient	*SE*	*Probit coefficient*	*SE*	*OLS coefficient*	*SE*
Husband in 2nd income quintile					-0.285 **	0.134
Husband in 3rd income quintile					-0.235 *	0.128
Husband in 4th income quintile					-0.184	0.127
Husband in 5th income quintile					-0.073	0.132
Less than 2 yrs in current neighbourhood			-0.040	0.030		
Father's pay, £/week	-0.047 ***	0.005				
Father's non-work income, £/week/10	0.005 **	0.002				
Mother's non-work income, £/week/10	0.010 ***	0.002				
Imr1 (work)					-0.057	0.057
Imr2 (use of formal childcare)					0.098	0.065
Constant	-3.840 ***	0.403	-5.593 ***	0.490	-3.720	3.301
Observations	7,096				1,016	
R-squared	-				0.206	
Log likelihood	-12013.978				-	
ρ	0.560 ***				-	

Note: First two columns estimate a bivariate-probit model for working status and the use of childcare. The third column estimates selectivity corrected OLS model for the price of childcare. Specifications include year dummies and regional dummies. *, **, and *** denote significance at 10%, 5%, and 1% level respectively.
Reference categories for categorical variables: white, one pre-school child, minimum schooling, living in London.
Standard errors bootstrapped.

Table 3.5 presents estimates for the joint model for employment and the use of formal childcare (columns 1 and 2) that are used to correct for selectivity in the price of childcare equation (column 3). The correlation coefficient ρ indicates that the bivariate probit is the correct method to estimate the joint employment-use of childcare decision since it is highly significant and positive as expected. The model predicting employment participation has the same covariates than the one presented in Table 3.4 with same magnitude effects, hence these results are not discussed here. Jointly estimated with the employment participation equation is the equation for the probability of using formal childcare. As a reminder, the use of formal care is a binary variable taking the value of 1 when the child is reported to be using childminder, nursery, playgroup or crèche care and the payment for this care is positive. Age and the level of education has the expected impact on the use of childcare with older and more educated mothers being more likely to purchase formal childcare. Non-white women are less likely to use formal modes of childcare, however, the possible differences between the ethnic groups are not accounted for due to small sample sizes. Age of the pre-school child is an important determinant of the decision to use formal childcare with the younger pre-school age children being more likely to be cared for informally, for example, by the mother. Surprisingly the price of childcare, however, is not dependent on the age of the child.

The variables used to identify the use of childcare equation are also used in studies by, for example, Powell (1998) and Jenkins and Symons (2001). The

variables indicating alternative caregivers in the household can be expected to reduce the likelihood of using formal care, while the regional availability of childcare should have a positive effect on the use.

The price regression reported in the third column of Table 3.5 show mostly expected results. The mother's years of schooling is positively related to the price of childcare she chooses. In other words, better educated individuals tend to choose a more expensive childcare option. The non-white pay over 20% less for their childcare which may reflect more reliance on informal childcare to supplement the formal care they use. Similarly, the presence of other adults in the household is associated with a lower cost paid for formal childcare. The number of pre-school age children is clearly associated with increasing economies of scale, however, surprisingly the age of the child has a non-significant effect although positive as expected. Increasing the number of childminder places in the local authority decreases the price paid for formal care as expected by economic theory. This significant relationship does not apply to the relationship between the price and the number of nursery or playgroup places. This is not completely surprising since the childminder is considered the more flexible and desirable childcare option by most parents (see Appendix 1 for more details on the UK childcare market). The local authority level variables on average wage and experience of childcare workers are positive and significant as expected. These variables partly capture the unobservable effect that higher quality care costs more but also regional differences within England. On the other hand, the

education of childcare workers fails to be significant but this may be due to very little variation in the level of education of childcare workers. The income quintile variables capture the fact that households with more disposable income tend to opt for better quality and hence more expensive childcare. The selection correction terms for work (*imr1*) and for the use of care (*imr2*) fail to be significant at the usual statistical level of significance. However, they are of the expected sign.

3.4.2 Employment-childcare use model results

Table 3.6 provides the empirical results of the main equations of interest, the bivariate probit results for the joint employment and use of childcare that are first introduced in equations 1 and 2 respectively. Table 3.6 reports the probit coefficients and hence for the elasticity estimates the reader should consult Table 3.7.

Table 3.6: Joint employment and use of childcare probits

	Employment		*Use of formal care*	
	Coefficient	*SE*	*Coefficient*	*SE*
Predicted wage, £/hour	0.872 ***	0.219	1.256 ***	0.234
Predicted price of childcare, £/hour	-0.426 ***	0.071	-0.284 ***	0.105
Age	0.158 ***	0.041	0.072	0.045
Age²	-0.002 ***	0.001	-0.001 *	0.001
Mother's school-leaving age, 17-18 years	0.127 ***	0.044	0.113 **	0.047
Mother's school-leaving age, 19-20 years	-0.068	0.092	-0.101	0.097
Mother's school-leaving age, ≥ 21 years	-0.240 *	0.143	-0.300 **	0.148
Non white	-0.149 **	0.064	-0.067	0.070
Two pre-school children	-0.478 ***	0.043	0.147 ***	0.045
Three pre-school children	-0.575 ***	0.069	0.166 **	0.075
Number of children aged 5-12	-0.127 ***	0.044	0.040	0.048
Number of children aged 12-16	0.018	0.071	0.869 ***	0.232
Age of pre-school child	0.025 ***	0.009	0.196 ***	0.010
Father's pay, £/week	-0.049 ***	0.005		
Father's non-work income, £/week/100	0.054 **	0.022		
Mother's non-work income, £/week	0.098 ***	0.023		
LA provision of nursery and playgroup care, places/1000			-0.011	0.009
*Supply*household income/100*			0.002	0.001
LA provision of childminder care, places/1000			0.018	0.014
*Supply2*household income/100*			-0.003	0.002
Working part-time			-0.610 ***	0.040
Adults dummy			-0.305 ***	0.085
Females aged 13-17			-0.614 ***	0.213
Males aged 13-17			-0.410 *	0.225

Table 3.6 continued

	Employment		*Use of formal care*	
	Coefficient	*SE*	*Coefficient*	*SE*
Less than 2 yrs in current neighbourhood			-0.039	0.030
Constant	-2.580 ***	0.508	-3.729 ***	0.598
Observations	7,096			
Log likelihood	-11983.907			
ρ	0.555 ***			

Note: Specifications include year dummies and regional dummies.
*, **, and *** denote significance at 10%, 5%, and 1% level respectively.

The first column of Table 3.6 reports the estimates of the employment equation of the bivariate probit. The predicted wage has the expected positive effect and the price of childcare has the expected negative effect on the probability of employment. The number of children and the father's working income both have an expected negative effect on the mother's employment behaviour since they affect the reservation wage of the mothers of young children.

The third column of Table 3.6 reports the estimated probit coefficients of the use of formal childcare equation of the bivariate probit. The predicted wage and price both have the expected sign with respect to the use of childcare. The number and the age of the pre-school age children in the household increase the likelihood of using formal childcare. However, surprisingly the provision of local authority childcare has no significant impact on the use of childcare[55]. On the other hand, variables that proxy the availability of informal childcare all have a negative, and in most cases significant, effect on the probability of using formal childcare.

The most important empirical result is that the predicted price of childcare exerts a significant negative impact on the decision to become employed as well as the decision to use formal childcare. Hence a reduction in the market cost of childcare should have a positive effect on both employment and the use of formal

[55] These statistics do not include private provision of childcare.

childcare. The extent of this effect is examined in the employment and use of childcare simulations presented in section 3.5.

Table 3.7 presents the elasticity estimates for married women with pre-school age children. The sign of the wage elasticity according to economic theory is ambiguous but in the empirical literature the sign is typically positive. One should bear in mind that the reported elasticities are just a measure of the mean effect and that different individuals may well have different wage elasticities.

Table 3.7: Price and wage elasticities for employment and formal care use

	Employment		*Use of formal childcare*	
Price of childcare	-0.173	***	-0.091	***
	(0.028)		(0.034)	
Wage	0.354	***	0.405	***
	(0.087)		(0.075)	

Note: Standard errors in parenthesis

The wage elasticity with respect to employment is estimated to be 0.35, therefore a 10% increase in wages would lead to a 3.5% increase in the employment participation of mothers of pre-school age children. The estimated elasticity with respect to the use of formal childcare is 0.41. In other words, a 10% increase in wages would increase the use of formal childcare by 4.1%. As Appendix 1 indicates the previous estimates for the wage elasticity of employment range from 0.04 in Michalopoulos et al. (1992) to 3.25 in Kimmel (1998) for the US. For the UK, Jenkins and Symons (2001) estimate the wage elasticity of employment to be 0.25 for single mothers. Unfortunately, they do not provide estimates for married mothers.

The price elasticity of demand measures the percentage change in the quantity of childcare demanded resulting from a given percentage change in the price of formal childcare. The price elasticity of demand for formal care with respect to employment is -0.17 indicating that across-the-board 10% decrease in the price of formal care would lead to a 1.7% increase in the employment participation rate of mothers of pre-school age children. Comparing the estimated elasticity of –0.17 to those found in previous literature, as summarised in Appendix 3, we can see that it lies in the lower end of the estimates found for the US. The estimates for the US range from –0.20 to –0.92 in studies by Connelly (1992) and Kimmel (1998), respectively. However, the UK estimate provided by Jenkins and Symons (2001) is –0.09. Berger and Black (1992) and Kimmel (1998) estimate the elasticity to be smaller in absolute value for single mothers as opposed to married mothers hence my estimate of –0.17 seems reasonable for the UK.

The price elasticity with respect to use of formal childcare is estimated to be -0.09. In other words, a 10% reduction in the price of childcare would lead to approximately 1% increase in the use of formal childcare. Hence a subsidy that results in a large cut in the price of childcare would have only a modest impact in inducing families to switch to formal childcare. Appendix 3 summarises a number of studies and indicates that the estimated price elasticity of childcare use is smaller than the previous estimates for the US, which range from –0.22 to –1.86 in studies by Ribar (1995) and Ribar (1992) respectively. However, the results of the current study may be biased due to the endogeneity of the variable

indicating the choice to work part-time. Both the prevalence of part-time work and the use of informal childcare in the UK are caveats that this chapter has not attempted to tackle but that should be on the future research agenda on this topic.

The estimated elasticities highlight the effectiveness of policy variables that affect the price, for example, the recently introduced childcare element of the Working Tax Credit (WTC). In general, since a ten percent decrease in childcare costs would lead to a modest 1.7% increase in the mothers' employment probabilities, childcare clearly is an inelastic good[56]. Hence the costs of the programme may not be recovered from increasing tax revenue, especially since the take-up of subsidies and tax credits is usually well below 100% (see Witte and Queralt, 2002 for US evidence). However, since childcare is a good with potential benefits to the society, not just to the individuals, a detailed cost-benefit analysis examining these issues would be desirable.

Furthermore, one has to keep in mind that the childcare market may not be perfect. In other words, the supply may not automatically adjust to the demand, for example, due to a shortage of childcare personnel[57]. Studies of this kind assume that the supply of childcare is perfectly elastic and that childcare is a normal good. These assumptions are questioned by, for example, Chevalier and

[56] Factors that affect the magnitude of the elasticity include the number and closeness of substitutes for the commodity. When there are no good substitutes, the good is more inelastic. Hence it is likely that the elasticity is lower in absolute value for mothers with no access to informal childcare arrangements.

[57] As long as the demand for childcare is inelastic, the producer can increase total revenue (TR) simply by increasing the price of childcare. If the producer increases the price, less of this commodity will be consumed hence resulting in smaller output and a smaller total cost of production (TC). Hence the consumers will be worse off while, with TR rising and TC falling, the profits (TR-TC) for producers increase.

Viitanen (2002) who conclude that the supply of childcare is inelastic. They find that in the UK women's labour force participation is constrained by the lack of childcare facilities. Hence the elasticity figure obtained here may not reflect the true elasticity that would prevail in the absence of excess demand for childcare.

3.5 Employment simulations

As a final exercise, this chapter reports the results of policy simulations in Table 3.8. The estimates of the basic economic model estimated in the previous section can be used to analyse key policy issues. In this section we simulate the employment and the use of formal childcare effects of revisions to childcare subsidisation policies that lower the price of childcare to the consumers of formal modes of childcare. The simulation results provide another way to gauge the magnitude of the estimated price effects. The simulated responses are obtained by computing mean probabilities for each of the alternatives in the choice set over the individuals and for different alterations in the budget constraint.

Table 3.8: Employment and use of childcare simulations

	Employment	*Use of formal childcare*
Baseline	50.7%	28.1%
50% subsidy	64.5%	36.2%
100% subsidy	76.1%	44.8%

Note: 7,096 observations

The first row of Table 3.8 lists the baseline employment and childcare utilisation rates from the sample. The baseline represents the predicted probabilities of formal childcare utilisation and labour force participation as they

are at the optimal point before any change in the budget set. Baseline simulations come very close to replicating the observed participation and use of formal childcare rates (50.5% and 27.4%, respectively).

The first policy change consists of a flat 50% subsidy on childcare expenditures. This policy would increase labour force participation by 13.8 percentage points to 64.5%. On the other hand, the use of formal childcare would increase by only 8.1 percentage points to 36.2%.

Previous research for the UK has found that a 25% decrease in childcare costs would encourage 1/3 of parents to use more care while with a 25% increase in costs 1/5 of respondents would reduce or stop using the childcare (La Valle et al., 2000)[58]. Their higher estimates may result from using a different metric (hours of childcare) rather than a binary variable for the use of formal childcare.

The second policy change provides a full childcare subsidy for all pre-school age children. Although as an out-of-sample prediction these estimates may be unreliable, this exercise is worth undertaking to compare the outcomes with the actual figures for Finland, where the childcare sector is highly subsidised. A 100% subsidy increases the average employment probability by 25 percentage points. In other words, provision of free care causes a 50.1% increase in the employment probability of married mothers of pre-school age children to

[58] This finding comes from a Baseline Survey of Parents' Demand for Childcare for children aged 14 and under in England and Wales.

76.1%[59]. The full subsidy for childcare would increase the use of formal childcare by 59.4% to 44.8%. Therefore 31.3% of mothers who work under the full childcare subsidy scheme would not use formal childcare. This suggests that many families prefer family care or relative care even when formal care is fully subsidised (see, for example, Duncan and Giles, 1996). This may be an indication of mothers perceiving the quality of formal childcare to be lower than informal care. A childcare subsidy would not affect their decision unless it induced them to switch from the informal to the formal childcare sector. Hence, childcare subsidies may not be a very effective policy for encouraging mothers to work if they fail to induce many mothers to take advantage of them and use formal care.

3.6 Conclusion

This paper has presented empirical evidence on the impact of wage rates and childcare prices on the joint employment-use of childcare choice decision of married mothers. The estimation results showed that, as expected, childcare price has a significant, negative effect on the probability of working and use of formal modes of childcare. This study examines the extent to which female labour force participation is affected by the costs of replacing maternal care with market care in England. This is done through the estimation of bivariate probits for work and use of formal childcare controlling for the expected wage and the price of

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[59] This compares favourably to actual labour force participation rates of over 70% for mothers of pre-school age children in Finland where all parents are entitled to a childcare subsidy ranging between 88% and 100% of the childcare costs depending on the income.

childcare. This method reflects the interrelated nature of the childcare choice and the labour force participation decision.

The empirical analysis is conducted using five years of the Family Resources Survey with additional local authority level information on the supply of childcare and local labour market characteristics.

The results confirm the findings of previous research. The opportunity cost of mother's time at home increases with the increase in her earnings as expected. Simultaneously accounting for non-random selection into use of formal childcare and employment, the estimated childcare price elasticity with respect to employment is -0.17 and with respect to the use of formal childcare is –0.09. The estimation results reveal that demand for childcare is relatively inelastic

Baseline simulations, 50.7% for labour force participation and 28.1% for the use of childcare, come very close to replicating the observed participation and use of formal childcare rates (50.5% and 27.4%, respectively). The simulation results show that if there were a universal zero-cost childcare available to the mothers in this sample the model predicts that 76.1% would be employed while only 44.8% would be using formal childcare. Almost a third of the mothers are hence predicted to use informal care when they work when childcare is provided free of charge.

The results indicate sensitivity of female labour supply to the price of childcare. The policy-relevance of this topic is closely related to current

government policy, for example, the Working Tax Credit (WTC). This policy relies heavily on a very elastic demand for childcare. The childcare element of the WTC distributes low-income working individuals money to be used for the payment of childcare. However, the decision to become employed depends on the characteristics of the individual as well as their wage and the price of the available childcare. Unfortunately this data does not cover the time period when the childcare component of the WTC, or its predecessor Working Families Tax Credit, has taken effect, however, the elasticity figures in this paper may give some indication of the likely impact of such policies.

CHAPTER FOUR: EXPERIMENTAL EVIDENCE OF A PRIVATE CHILDCARE VOUCHER

4.1 Introduction

In the past three decades, female labour force participation has increased in most Western countries, particularly for mothers of pre-school age children. In most countries this shift has put a strain on the provision of formal childcare leading to problems commonly associated with a market failure. As a consequence government policies have been formulated to assist both the supply and the demand side of the childcare market.

The formulation of most effective government policies requires the knowledge of the responsiveness of the consumers to the price of childcare. Hence, numerous studies have examined the impact of the price of childcare on the labour force participation and the use of childcare.

Ideally the impact of the price of childcare on the labour force participation and the use of childcare is examined in an experimental set-up. An exogenous shock in the price of childcare that affects the household budget constraint allows us to identify the impact of the price of childcare on labour force participation and the use of formal childcare.

This paper relies on an experimental set-up to estimate the impact of a private childcare voucher on labour force participation and the use of childcare. As argued by Kreyenfeld and Hank (2000), an extensive public provision of

childcare may discourage private providers from entering the market for childcare. However, there is evidence that the voucher for private childcare for Finland facilitated the market entry of new participants hence increasing the availability of childcare in the experimental regions.

The increased availability of childcare places provides an exogenous shift in the price of childcare faced by the parents who resided in the experimental regions where the voucher was available. This in turn allows the identification of the impact of the price of childcare on the labour force participation and the use of childcare.

The next section examines the literature on childcare financing and vouchers specifically. Section 4.3 explains the voucher experiment in more detail while section 4.4 explains the econometric method used in the analysis. Section 4.5 through to section 4.7 includes a description of the data and the estimation results while section 4.8 concludes with a discussion of the policy implications of the main findings.

4.2 Previous literature

Previous studies have found that high-quality publicly subsidised childcare encourages the labour market activity of mothers of pre-school age children (see, for example, Gustafsson and Stafford, 1992 or Kajanoja, 1999). However, a full childcare subsidy, which is common in continental Europe, interferes with market mechanisms. For example, Ilmakunnas (1997) and Kreyenfeld and Hank (2000)

argue that heavily subsidised public provision of childcare prevents competition from private providers due to high barriers to entry[60]. Therefore, depending on individual preferences for private versus public childcare, some people may be discouraged from entering the labour market. Along the same lines, Bradford and Shaviro (2000) discuss the importance of competitive private supply. They argue that public provision creates monopoly power and misdirected bureaucratic incentives. On the other hand, the private sector with their profit motive combined with the need to satisfy customers induces both cost-saving production and socially valuable innovation. Hence it is cheaper to produce despite subsidies.

A universal childcare subsidy is subject to a large deadweight loss since it subsidises families that would be willing to pay the market price for childcare in the absence of the subsidy (Duncan and Giles, 1996)[61]. The deadweight loss is considerable in Finland, first, because every child is provided a child subsidy regardless of household income and, second, because the parental contribution towards the total cost of the universal childcare provision is small even for the highest income groups (see Appendix 2 for more details on the Finnish family policy).

Vouchers are a classic way to finance a quasi-market, where private sector mechanisms are transferred to the public sector, and have been widely used in the

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[60] Parents' willingness to pay for private childcare may be low since under the system of public provision of childcare they are used to paying low fees.
[61] More extensive discussion on childcare subsidies and their simulated impacts for the UK can be found in Duncan et al. (1995).

provision of education or healthcare[62]. Vouchers increase the efficiency of the market by introducing consumer choice and therefore increased competition between providers[63]. A voucher system enables parents to choose freely between the public or "subsidised private" sectors of the childcare market. Users ("buyers") create demand for one establishment rather than another. Establishments ("sellers") react by expansion, contraction, or adjustment of costs and quality. The increased consumer choice and competition has the following positive aspects: price decreases while the provision increases, which leads to increased consumer satisfaction (Bradford and Shaviro, 2000). Since childcare vouchers for low-income families were introduced in the US, there has been an unprecedented increase in the number, quality and variety of providers available responding to parents needs and preferences, for example, regarding the hours of care needed (Besharov and Samari, 2002).

The Finnish Government Institute for Economic Research (VATT, 1995) discusses the possible merits and disadvantages of a childcare voucher system. Ideally this type of quasi-market combines the best components of a competitive market and the public system. Specifically, a quasi-market may be more responsive to changes in demand. Additionally, VATT (1995) notes the importance of taking into account the effect of the voucher combined with the

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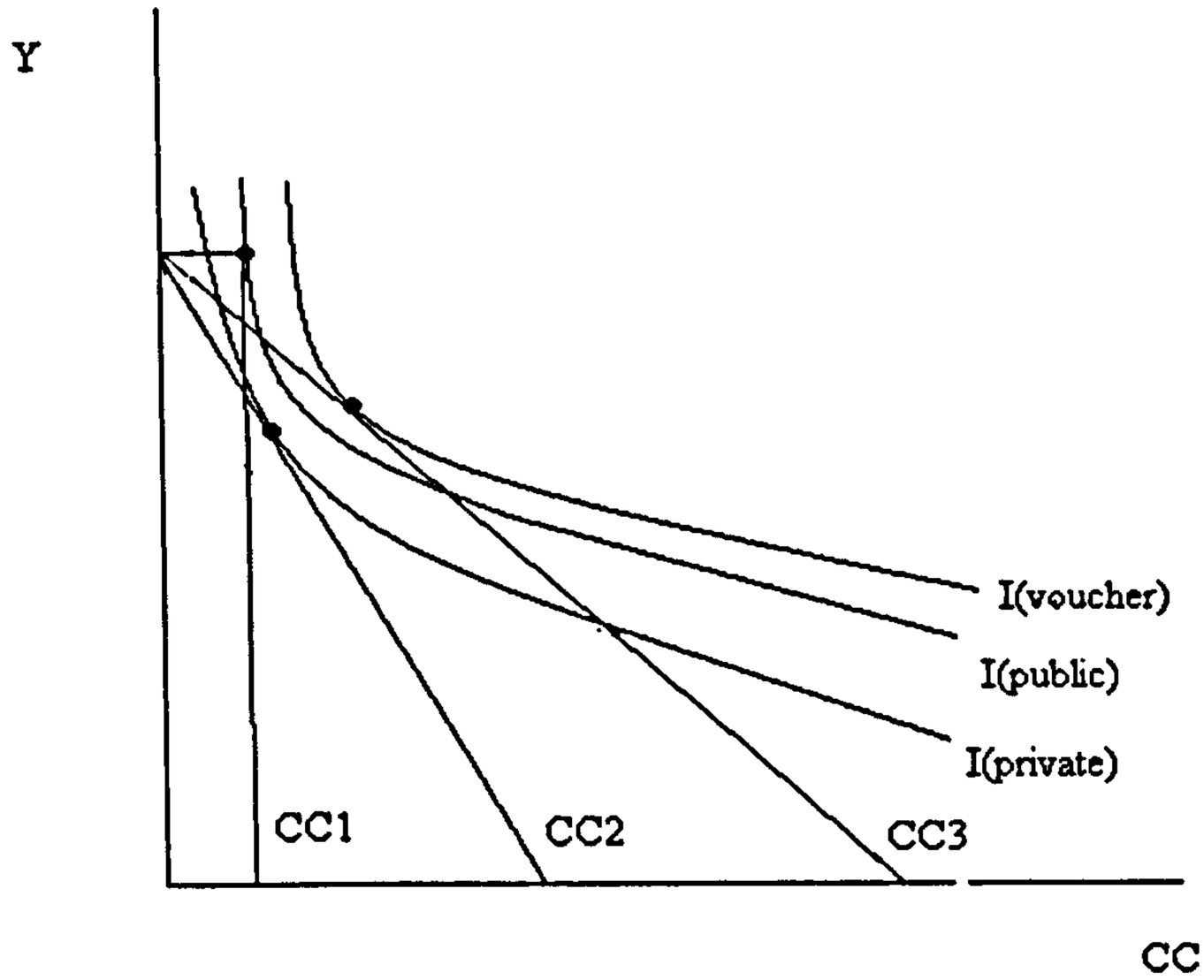
[62] Steuerle et al. (2000) provide a comprehensive review of vouchers used for financing of public services.

[63] However, Besharov and Samari (2000) note the importance of calibrating the childcare voucher payments to the local market conditions to prevent subsidies meant for low-income families to benefit more affluent families or increasing profits for providers. Similar issues are also discussed in Duncan and Giles (1996).

effects of the tax system, housing subsidy and childcare fees. In particular, a means-tested voucher combined with other income-conditioned aspects of the tax-transfer system may lead to a combined effective marginal tax rate approaching or even exceeding 100% hence leading to incentive problems.

Figure 4.1 depicts the decisions of parents between public childcare provision, private (non-subsidised) childcare provision and voucher-subsidised private provision assuming that families have well-behaved preferences. On the x-axis is the amount or quality of childcare purchased (CC) and on the y-axis all other goods (Y). The budget constraint for publicly provided childcare is rectangular because in the Finnish context it is provided largely free of charge, or for a low fee, which allows the household to spend its income on alternative consumption (Y). The children attending public childcare receive CC1 amount of care.

Figure 4.1: Budget constraint effect of a private childcare voucher



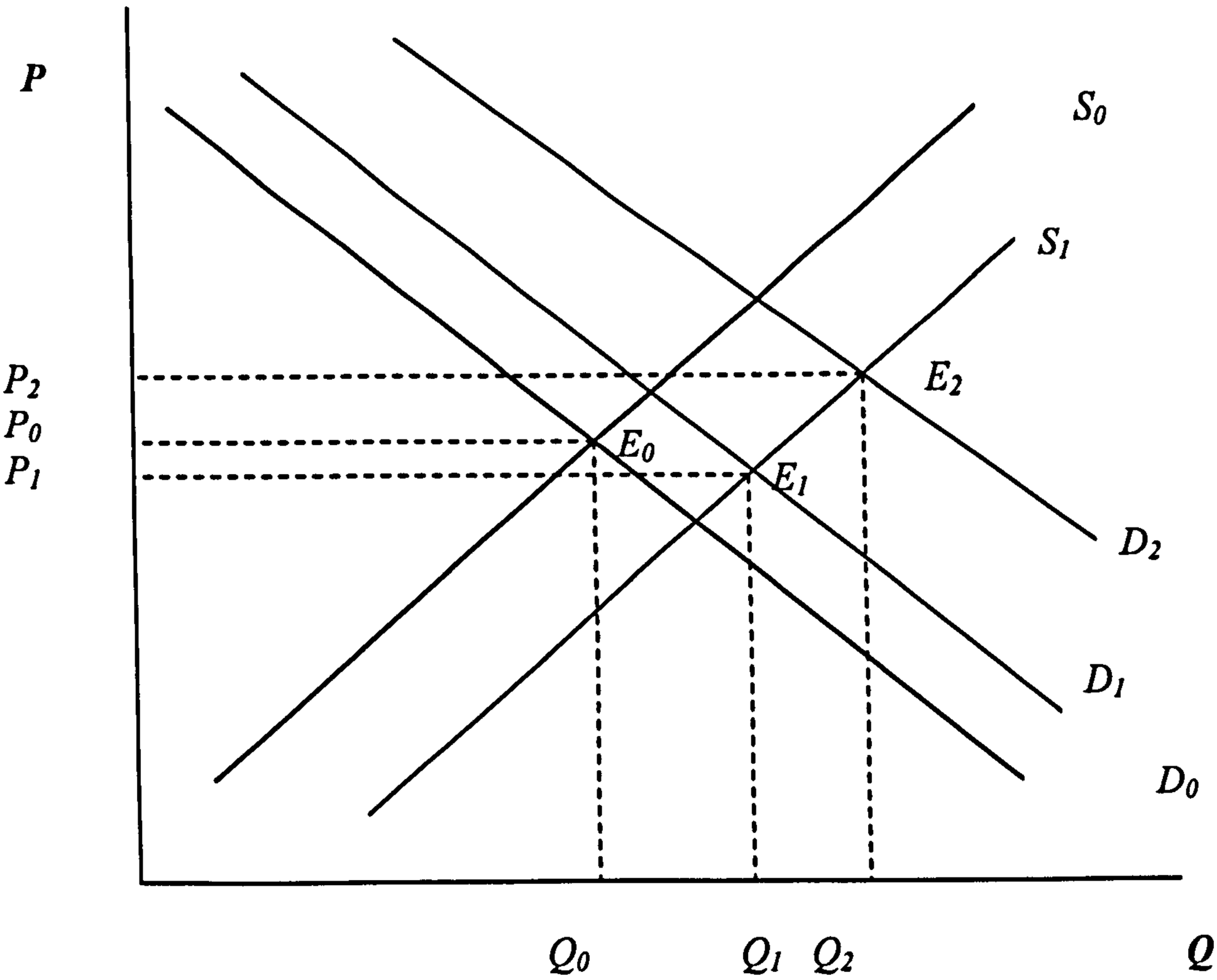
Private childcare provision may be a more desirable option for some households according to parental preferences (for example, better opening hours, a more convenient location, or some aspect of the perceived quality of childcare). However, the budget constraint CC2 for privately provided childcare is very steep[64]. In other words, the household must give up many units of Y to purchase an additional unit of CC. Figure 4.1 depicts a situation in which the utility of choosing the public childcare provider is higher than the utility derived from privately provided childcare because the extra cost outweighs the extra benefit derived from attending a private childcare provider.

[64] The two goods, public childcare and private childcare, are substitutes as most childcare is provided full-time and hence the budget constraints CC1 and CC2 are drawn as separate lines not allowing a combination of both types of care.

A private childcare voucher shifts the budget constraint for private care from CC2 to CC3. Because the voucher subsidises the cost of private childcare to the parents, the new budget constraint is much flatter depending on the amount of the voucher. Hence depending on the flatness of the budget constraint, the household could reach a higher level of utility I(voucher) and a higher level of CC as depicted in Figure 4.1.

According to this simple analysis, a private childcare voucher can be expected to increase the use of private childcare on average, either as a substitution away from public childcare to private childcare or as new entrants to the childcare market. In the former case it can be expected that the hours of work of the main caretaker in the household (usually the mother) will stay the same or increase if the previously used public provision did not adequately accommodate her working behaviour. In the latter case there should be an increase in the participation probability of mothers of pre-school age children.

Figure 4.2: Market for childcare with a voucher



The voucher can be expected to increase the overall supply of childcare since more private providers will enter the market (move from S_0 to S_1) in Figure 4.2. The decrease in the price of childcare (P_0 to P_1) resulting from increased competition is expected to increase the demand for childcare. The magnitude of the effect depends on the income and price elasticities of demand for and supply of different types of care (move from D_0 to D_1 or D_2)[65]. Hence the overall effect of the voucher on the price of childcare is ambiguous. Furthermore, if private

[65] As a general rule, short-run elasticities are lower in absolute value than long-run elasticities.

providers have local monopoly power, they may try to capture part of the voucher.

4.3 The Finnish voucher experiment

Childcare costs in Finland represent 1.4% of GDP. The childcare is provided by municipalities, which finance it through municipality taxes and contributions from the central government. Users pay a means-tested fee, which is fixed by the municipality, of up to €168 per child (in 1998). However, the payment by the consumers of childcare only covers approximately 15% of the total cost of childcare. The high level of public expenditure has led to pressures to enhance its effectiveness (Hemmings et al., 2003).

The large public provision of childcare has led to an inefficient outcome where many municipalities suffer from excess demand while at the same time others experience excess supply[66]. Clearly the universal provision of public childcare is inefficient and costly. Overall, more than 20% of municipalities could not meet their childcare requirements (Palokangas, 1995). To cope with the discrepancy between the supply and the demand for childcare, Palokangas (1995)

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[66] Palokangas (1995) find that overall the supply and demand for childcare do not meet; in 1994, there was an oversupply of about 7100 places but also excess demand of 2800 places varying by region mostly for 3-6 year olds and part-time places. The Ministry of Social Services and Health (1998:20) find that most excess demand was found in the municipalities of Espoo, Vantaa, Helsinki (which are in the treatment group of the experiment), Savonlinna, Lahti and Lappeenranta (which are in the control group of the experiment).

suggests the introduction of vouchers for childcare services as well as introducing a needs-basis for childcare[67].

By introducing competition to the market for childcare, the vouchers should lead to efficiency gains. In general, enhanced competition boosts private initiatives, which leads to an expansion of the market for childcare services. Moreover, private childcare provides parents with more choice and suitable care, for example, longer opening hours allowing atypical employment. Hence, at the margin, the voucher is expected to increase both the labour force participation and the use of childcare of mothers of pre-school age children.

The early 1990's recession forced municipalities to cut costs in all public services including public childcare provision. As a consequence, the childcare services concentrated on providing the services that were required by law and reduced the financing for discretionary after-school care and playgroups. In this spirit, the voucher experiment started with a main objective of reducing the costs of provision of childcare as well as increasing childcare availability. The goal of the experiment was not to privatise childcare services but instead to get the benefits of competition in the market for childcare, in particular to reduce the dead-weight loss and concurrently to give parents more choice regarding the type of childcare services they have available. The voucher experiment lasted from

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[67] The right to a childcare place in Finland does not require the parents to be employed or in full-time education.

1.3.1995 to 31.7.1997, and it was administered by the Ministry of Social Services and Health.

The municipality representatives who were interviewed before the start of the experiment guessed that the private childcare voucher would increase the cost of childcare but have zero (71% of respondents) or negative effect (20%) on the demand for childcare (Heikkilä and Törmä, 1996).

The voucher is a child-specific subsidy for privately provided childcare for any pre-school age child. It is available from the date the parental leave (vanhempainrahakausi) ends as the child turns three years old (see Appendix 2 for more details on the Finnish family policy including parental leave) until the child reaches school age at seven.

Each municipality pays a subsidy to the private childcare provider chosen by the family. The amount of the subsidy varies by municipality. The private childcare providers are entrepreneurs[68], however, they face the same laws regarding child-staff ratios and educational requirements of the staff as publicly provided childcare and are regularly inspected by the municipality[69].

Privately produced childcare is in general cheaper to produce than public care[70]. On the organisational level the private childcare is less bureaucratic with the entrepreneur as the sole decision-maker regarding the business. Additionally,

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[68] The private childcare is exempt from VAT.
[69] Average child/staff ratio is 4.2 in daycare centres and 2.8 in childminder care.
[70] However, there has not been any municipality level analysis on whether private childcare is cheaper for the parents.

private childcare can be thought to have a comparative advantage in producing more specialised care as well as providing more flexible opening hours and more interaction with the parents and the childcare personnel[71].

By the beginning of 1995, 33 municipalities, out of 450, reported wanting to take part in the experiment and all were accepted. Out of the 33 participating municipalities, 13 were cities and half of the remaining participants were small municipalities of less than 10,000 inhabitants. Most of the participating municipalities were in the government office regions of Uusimaa (12), Pohjois-Karjala (6), and Häme (4) with the rest distributed across the country (Appendix 5 shows the geographical location of the participating municipalities and names the municipalities taking part in the experiment). Six municipalities are excluded from the analysis due to inconsistencies in their participation, for example, a few municipalities started the voucher experiment before others in 1994.

Eligibility to receive vouchers typically depends on personal and household characteristics. The amount and the type of the voucher were chosen freely by the municipality to best suit their needs. 21 municipalities chose a means-tested voucher (€140-366/month/child for 0-2 year olds; €128-343/month/child for 3-6 year olds) while 12 municipalities gave out a lump-sum voucher (€304/month/child on average for 0-2 year olds; €263/month/child on average for 3-6 year olds). On top of the voucher, the childcare centres can charge additional

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[71] The personnel may also be less unionised but there are no statistics available to confirm this hypothesis.

fees. Since this fee is chosen freely between the provider and the customer, the childcare providers can cater for different parental preferences regarding the hours of the type of childcare[72]. About half of the families in private care pay between €168 and €252 a month on top of the voucher. A fifth of the families using vouchers pay more for private care on top of the voucher than they would pay for public care.

Heikkilä and Takala (1999) and Takala (2000) surveyed a sample of families with pre-school age children after the experiment. They conclude that the families choosing the private childcare voucher have a higher level of education and a higher occupational status (approximately 80% were in professional or managerial occupations).

The finding that families with a higher socio-economic status are more likely to use private childcare is also reflected in the price paid for this mode of care. A quarter of the families using private childcare pay over 10% of their disposable income for the fees (however, most of these are low income families) while this percentage is only 14% for families using publicly provided childcare (Takala, 2000). The highest payment for public childcare is approximately €168 per month and about 40% of families using the care are in this group, while 13% of families are exempt from fees. In general, private care is more expensive, for example, while 13% of families using public care pay over €252 per month on top

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[72] Helsingin Sanomat "Joka viides päiväkoti on yksityinen" and "Yksityinen päiväkotiketju aikoo kasvaa ripeästi" 2.12.2002.

of the voucher for the care of all their children, this proportion for private care users is 27%.

For the municipalities, using vouchers has been cheaper than producing the care themselves (Heikkilä and Törmä, 1996). On average, the voucher cost €50 less per child per month than the publicly provided care. The savings varied by municipality depending on the amount of the voucher. While the private care accounted for approximately 6% of all childcare provision, the average costs for the municipalities were only 1.5% of total childcare spending. The cost of private care provision is between 60% and 90% of the comparative public care. The survey did not examine the main reasons for the cost differential. However, the main reasons are believed to include lower bureaucracy and the ability to turn away potential customers, for example, children under the age of three who are more costly to care for in formal childcare settings.

Of the families choosing the voucher, 17% moved into private care from public care, and 45% were already customers in the private care[73]. A quarter of the families were given the voucher as an only option due to excess demand for publicly provided childcare. In a survey by the Ministry of Social Services and Health, 41.2% of families use specialised childcare (most commonly care with foreign-language, music or art oriented activities)[74]. Families choosing the

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[73] The deadweight is large, however, there is large public support for subsidised childcare for all income groups (see Bergstrom and Blomquist, 1996 for more details).

[74] The percentage is over 80% in Helsinki and higher than average in other municipalities in the capital region.

voucher and using privately provided childcare, on average, subjectively valued the quality to be better than those using public care[75].

The Ministry of Social Services and Health (1997) examine the experiment and note that it brought about a good base for changing attitudes towards the production of childcare, moving away from the traditional model of municipality produced childcare, which is financed by tax revenue. As a consequence, even small municipalities witnessed a rise in the private production of childcare. A survey finds that 22% of the private childcare entrepreneurs who were in operation in 1998 started their business when the voucher experiment started. Of the entrepreneurs that started their business during the experiment, 59% reported that the reason for starting was the private childcare voucher (Johtoryhmän muistio, 1997).

The municipalities have expressed their wish to maintain the acquired level of private childcare provision and many have increased the amount of the private care subsidy after the experiment (Johtoryhmän muistio, 1997). The experiment was deemed a success and a private childcare subsidy was introduced nationally in 1997. By 2002, a fifth of all childcare centres (approximately 3,000 in total) in Finland were private enterprises accounting for about 6% of all childcare places.

The Ministry of Social Services and Health (1998) interviewed municipality representatives after the experiment finished in 1997 and found that private

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[75] The subjective quality is reported to be better in the private sector in terms of co-operation between the family and the childcare centre. Public care was considered especially good in terms of food, rest and safety.

childcare is available in 85% of the bigger municipalities (over 10,000 inhabitants) and 53% of the smaller municipalities (less than 10,000 inhabitants)[76]. Additionally, in a third of the municipalities, the private childcare provision has increased during the experiment and the provision did not decrease in any of the surveyed municipalities.

A new law regarding private childcare subsidies was ratified immediately after the experiment ended on 1.8.1997. This subsidy is paid to the private childcare provider appointed by the parents including nurseries, childminders, and nannies. Unlike the experimental voucher, the nationally adopted private care subsidy enabled the child to be taken care of at home by a nanny as well as in a private nursery[77]. The subsidy is a tax-free transfer when used to hire a childcare provider. Each child is eligible for the private care subsidy from the end of the parental leave period until the school starting age of seven. The subsidy is €118 per month per child with a means-tested add-on of up to €135 per month per child. Many municipalities introduced a higher level of subsidy than the minimum legal requirement.

This research is of immediate interest for the Finnish policy makers but more generally, our findings provide essential input in the policy making process in many countries that are currently struggling with excess demand for childcare (see Chapter 2 for UK evidence).

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[76] Unfortunately it is not possible to identify municipalities with zero provision of private childcare in the data.

[77] The private care subsidy is handed out by the Finnish Social Insurance Institution (KELA), while during the experiment the subsidy was administered by the municipality concerned.

Overall, the universal public provision led to excess supply of childcare at the national level. Thus, our estimates provide a lower bound estimate for most countries where excess demand is experienced nationally. However, many municipalities in the experiment (including three in the capital region) experienced excess demand. Hence using this information we can also evaluate the impact of the voucher under the conditions of demand outstripping the supply of childcare services.

4.4 Econometric method

Meyer (1995) examines the use of natural and quasi-experiments in economics. He explains that good natural experiments are studies in which there is a transparent exogenous source of variation in the explanatory variables that determine the treatment assignment. A natural experiment induced by, for example, a policy change may allow the researcher to obtain exogenous variation in the main explanatory variables. This occurrence is especially useful in situations in which the estimates are ordinarily biased due to omitted variables or selection effects.

The childcare voucher experiment is a policy change that results in exogenous variation in women's labour force participation and their use of formal childcare. The difference-in-differences estimator (referred to DD from hereafter) gives the effect of the policy change by comparing the changes in the outcomes of the treatment group with the outcomes of the control group (see, for example,

Blundell and MaCurdy, 1999). The validity of this estimator rests on the assumption that the treatment and the control group would behave identically in the absence of the policy change i.e. that they share a common macro effect as well as a time-invariant group effect.

The DD method is a before-and-after design with an untreated comparison group. The regression adjusted DD estimates can be formalised as follows:

$$y_i = \alpha_1 + \alpha_2 Z_i + \alpha_3 T + \alpha_4 G + \beta (T \times G) + \varepsilon_i \quad (4.1)$$

, where *T=1* after the start of the voucher experiment and *0* otherwise, *G=1* for the treatment group and *0* otherwise, and *T×G* is their interaction while *Z* includes individual and household characteristics. The *T×G* is a dummy for being in the experimental group after it receives the treatment and β is the true causal effect of the treatment on the outcome for this group.

The difference-in-differences approach gives the average treatment effect on the treated. Two important assumptions underlying the difference-in-differences approach include: (1) common time effects across groups and (2) no systematic composition changes with each group[78]. A key idea is that α_3 summarises the way that both groups, *G=1* and *G=0,* are influenced by time effects, for example, macroeconomic conditions or regional growth in employment trend. There may

[78] These problems are especially prevalent when using cross-sectional data. It is then possible that the before-after comparability is not valid due to variation between the groups in their fixed effect component. Further research will examine the extent of this problem in this study.

be a time-invariant difference in overall means between the two groups but this aspect is captured by α_4 (see, for example, Blundell and Costa Dias, 2002 for more detailed discussion). The main coefficient of interest in the difference-in-differences model β can be estimated directly by applying OLS to equation (1). A key identifying assumption is that $\beta=0$ in the absence of the treatment.

Meyer (1995) points out that DD estimation can be sensitive to non-linear transformation of the dependent and independent variables, hence all the analysis using the DD framework is undertaken using OLS even for limited dependent variables.

A weakness of experiments is that their results may not be easy to generalise beyond the group of individuals or the setting used in the study. Internal validity threats to DD studies include serial correlation, which may lead to standard errors that are biased downwards (see, for example, Bertrand et al., 2004). The solutions to compute consistent standard errors include, for example, 1) collapsing the data into pre- and post-reform periods, 2) allowing for an arbitrary autocorrelation process when computing the standard errors, or 3) block bootstrapping. However, Hanushek et al. (1996) provides evidence that omitted variables bias tends to increase along with the level of aggregation.

In studies based on comparisons of reforming and non-reforming states, the most important threat probably comes from the possibility that changes in legislation are endogenous. The DD approach relies on a strong assumption that

the unobservables in the error term are uncorrelated with the policy change of interest. At the aggregate level the problem involves the self-selection of municipalities into the voucher experiment. Takala (2000) notes that the experiment areas are not significantly different from each other when it comes to observable characteristics, for example, municipality finances. However, quite often it seems that neighbouring municipalities have similar policies where one has learned about the potential benefits from their neighbour.

To examine whether the non-random assignment into the treatment group biases the DD estimates, we provide estimates using propensity score matching[79]. Matching experiment area individuals to their closest counterparts in the control area solves the problem that the treatment and controls areas may be quite different, on average, in their demographic composition. However, it does not account for differences in unobservable characteristics between treated and untreated areas. The advantage of using propensity score matching in this analysis is that it matches like individuals on their observable characteristics, whereas the DD approach compares the average characteristics of the treatment and the control regions.

A further advantage of propensity score matching over DD estimation is that the matching approach relaxes the linearity assumption inherent in the DD

[79] This research estimates the effect of treatment not allowing for multiple, simultaneous treatments. Future research plans include estimating the separate effects of different treatments jointly (for further details on multiple treatment effects, see Lechner and Pfeiffer, 2001).

approach while maintaining the assumption of selection on observable characteristics.

Only matching highlights the support problem in a way that is often overlooked in a regression analysis. The common support condition requires that conditional on the set of observable characteristics *Z*, the probability of observing both the participants and the non-participants is positive. In my case, if the municipalities are different in the first place, then a regression analysis will not identify the impact of the voucher. Instead what is identified in this case are the pre-existing differences in the municipalities' provision of childcare or employment prospects, for example.

The lack of common support may lead to biased estimates of the effect of the treatment on the treated (see Heckman et al., 1997 for details). Hence, it is crucial that the common support is as large as possible otherwise the matching is done on the tails of the two distributions i.e. matching individuals that are quite different in their observable characteristics.

A primary assumption underlying matching is the conditional independence assumption (CIA), which states that the treatment status is random conditional on a set of observable characteristics *X*. The CIA will be satisfied if *X* includes all of the variables that affect both participation and outcomes (see, for example, Rosenbaum and Rubin, 1983). Rather than matching on *X* it is equivalent to match on *P(X)*, thus avoiding the problem of dimensionality.

All matching estimators can be written as follows:

$$\hat{E}(Y_0 \mid \hat{P}(X_i)) = \sum_{j=1}^{J} w(\hat{P}(X_i), \hat{P}(X_j)) Y_{0j} \tag{4.2}$$

where subscript *i* denotes treated individuals and *j* indexes the untreated comparison group observations. The matching estimator constructs an estimate of the unobserved counterfactual for each treated observation by taking a weighted average of the outcomes of the untreated observations. The difference between the various matching estimators lies in the type of weighting placed on the *j*th observation in constructing a counterfactual for the *i*th treated observation.

This paper uses two alternative matching estimators: the nearest neighbour estimator and the Epanechnikov kernel matching estimator. The weighting for the nearest neighbour matching estimator takes the following form:

$$w(\hat{P}(X_i), \hat{P}(X_j)) = \begin{cases} 1 & if \quad j = \underset{k \in \{D=0\}}{\arg\min} \{ \mid P(X_i) - P(X_k) \mid \} \\ 0 & otherwise \end{cases} \tag{4.3}$$

The nearest neighbour matching estimator assigns the weight of 1 to the comparison observation with the closest propensity score to each treated observation and 0 to all other observations. The nearest neighbour estimator does not impose a support condition but instead constructs a counterfactual for every treated observation no matter how large the distance is to the propensity score of the nearest comparison group observation. Hence, to overcome this potential problem, the nearest neighbour estimator is combined with a caliper. A caliper

defines an interval around each treated unit within which the propensity score of a control individual should lie for it to be included in the estimation. The nearest neighbour matching in this paper is done with replacement[80].

Rather than relying on a single control, it is possible to construct a synthetic individual based on a group of control individuals. The weight attached to each control is given by a kernel. The kernel matching potentially assigns a non-zero weight to several observations in the comparison group in constructing the counterfactual for each treated observation. The standard form for the weighting function is given by:

$$w(\hat{P}(X_i),\hat{P}(X_j)) = \frac{K\left[\frac{\hat{P}(X_i)-\hat{P}(X_k)}{a_n}\right]}{\sum_{k\in\{D=0\}} K\left[\frac{\hat{P}(X_i)-\hat{P}(X_k)}{a_n}\right]} \tag{4.4}$$

where $K(.)$ is a kernel function and a_n is a bandwidth. As mentioned earlier, we use the Epanechnikov kernel which takes the following form:

$$K(\psi) = \begin{cases} \frac{3}{4}(1-\psi^2)\ if\ |\psi|<1 \\ 0 \quad otherwise \end{cases} \tag{4.5}$$

Asymptotically, all the matching estimators produce the same estimate because they all end up comparing only exact matches. However, in finite

[80] Matching without replacement keeps variance low at the cost of potential bias while matching with replacement keeps bias low at the cost of larger variance.

samples, different matching estimators produce different results because of the variation in the weighting (see Dehejia and Wahba, 2002 for details)[81].

A further threat to the validity of the estimates results from the fact that this paper analyses partial equilibrium effects. In other words, the impact of the treatment is estimated when only a proportion of the population is treated. The following estimation assumes no general equilibrium effects i.e. persons outside the experimental treatment area are not affected by the treatment. This includes the assumption of, for example, the costs of private childcare in untreated municipalities being independent of whether a neighbouring municipality is treated. In the statistics literature this assumption is called the stable unit treatment value assumption (SUTVA). The results may be different when the full population is treated, however, this issue is not dealt with in this paper.

4.5 Data description

The estimation uses data from the Income Distribution Survey[82] (referred to as IDS from hereon) from 1994 until 1997. The IDS is a rotating panel survey interviewing 10,000 households per year. Each household is interviewed for two consecutive years. The interview data is linked with data from administrative registers, for example, on income and subsidies. All the data are provided on an

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[81] The choice of the matching estimator depends on the data. For many and evenly distributed comparison observations, the multiple nearest neighbour provides the best estimates while for many and asymmetrically distributed comparison observations kernel matching may be the best choice. Local linear matching should be used when there are many observations with the propensity score near zero or one.

[82] Tulonjakotilasto in Finnish.

annual basis, for example, employment participation is reported as months per year.

The information on the municipality of residence is not released in the IDS due to confidentiality reasons. Instead Statistics Finland has, on request, created dummies to identify the experimental regions including any variation in the type of voucher.

The childcare voucher experiment was administered between 1.3.1995 and 31.7.1997. Hence the pre-treatment period is 1994, which is denoted *T=0* henceforth. The experiment period includes year 1995 to 1997, denoted *T=1*. The experiment began on 1.3.1995 hence the first two months of the year are not affected by the experiment. Similarly, in 1997 the last five months of the year are not affected by the experiment. However, this should not affect the estimation results and any bias resulting from the time frame should reduce the coefficient estimates.

The childcare information has been included since 1994 and includes questions on the type of care, amount used during the year and payment made on childcare during the year. The childcare questions are part of the interview. A comparison to several national datasets in Vaajakallio (1999) concludes that any inaccuracies are due to different survey periods but the data is representative of the whole population.

The childcare questions in the IDS are asked per child for each household with children under the age of nine. All different types of care and the corresponding months of use and payment are recorded. Unfortunately the data does not include information on the amount of the private childcare voucher received. Furthermore, it is not possible to accurately predict the amount due to variation in the amount of the voucher between the participating municipalities.

Table 4.1: Sample derivation (IDS 1994-97)

	Number of observations
Original 1994-97 data	29,083
Drop voucher problem regions	27,676
Drop households without 0-6 year olds	20,427
Drop men and children	5,904
Drop single parents	4,511
Drop if father not employed	4,355
Expand data by child aged 0-6	6,651

The estimating sample includes all the mothers with pre-school age children (aged 0-6) who are married or cohabiting and whose partner works[83] (see Table 4.1 for details). Some regions were dropped from the sample because they do not represent either the control or the treatment region, for example, in some cases the private childcare voucher was used prior to the start of the experiment. Single mothers are not used in the analysis because of the small sample sizes, especially for the treatment region. The unit of observation is a pre-school age child, hence each mother observation is weighted by the number of pre-school age children. The estimation is corrected to account for the multiple occurrences in the data.

[83] Non-employed fathers are dropped from the analysis because of the requirement to work in one type of voucher.

The final estimation sample is 6,651, of which 2,618 are mothers of 0-2 year old children and 4,033 are mothers of 3-6 year old children.

Table 4.2: Pre-experiment summary statistics (1994)

	Control G=0	*Treated G=1*	*Difference*
Work	0.692 (0.462)	0.665 (0.473)	
Use of formal care	0 .379 (0.485)	0.506 (0.501)	***
Age	32.605 (4.874)	32.977 (4.563)	***
Dad's age	35.622 (5.476)	34.900 (5.118)	
No. of children <7	1.838 (0.870)	1.772 (0.673)	***
Age of youngest child	2.200 (1.867)	2.223 (1.789)	
Size of household	4.613 (1.375)	4.297 (1.017)	***
Mother's schooling			
Compulsory school	0.106 (0.308)	0.102 (0.303)	
Baccalaureate	0.450 (0.465)	0.366 (0.482)	***
Baccalaureate plus vocational	0.316 (0.465)	0.309 (0.463)	
Bachelors	0.048 (0.213)	0.046 (0.210)	*
Masters and above	0.081 (0.270)	0.177 (0.375)	***
Father's schooling			
Compulsory school	0.181 (0.385)	0.118 (0.323)	***
Baccalaureate	0.485 (0.500)	0.348 (0.476)	***
Baccalaureate plus vocational	0.165 (0.371)	0.156 (0.378)	
Bachelors	0.065 (0.247)	0.100 (0.310)	***
Masters and above	0.104 (0.303)	0.279 (0.415)	***
Capital region	0.003 (0.051)	0.505 (0.500)	***
Cities	0.373 (0.484)	0.300 (0.459)	***
Densely populated municipalities	0.224 (0.417)	0.107 (0.310)	***
Rural municipalities	0.400 (0.490)	0.087 (0.282)	***
Unemployment rate	0.210 (0.044)	0.163 (0.044)	***
Number of observations	1,134	391	

Note: Standard deviations in parenthesis.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.

Table 4.2 reports the summary statistics separately for the control region *G=0* and the treatment region *G=1* for 1994. Column 3 of Table 4.2 reports the results of a test for differences in the means between the control and the treatment region. There are no significant differences in the working status of the control

and treatment region, however, the use of formal childcare is about 13 percentage points lower in the control region before the start of the experiment. Another significant difference between the control and the treatment region is the level of unemployment, which is almost 5 percentage points higher in the control region[84]. Significant differences exist also for the number of pre-school age children as well as the size of the household.

There are significant differences in the level of education between the control and the treated region for both mothers and fathers of the pre-school age children. Mothers are more likely to have finished their schooling at the baccalaureate level in the control region whereas, in the treated population, significantly more women have acquired at least a Masters degree. A similar trend is observed for fathers' level of education. Therefore on average the treated region is more educated. These differences are partly due to the fact that the capital region accounts for about 51% of the treated areas and that there is over 30 percentage point difference in the proportion of rural municipalities between the two groups.

Table 4.3 provides a simple difference-in-differences calculation for selected variables of interest. Throughout the analysis, the main variables of interest are labour force participation (referred to as LFP from hereafter) and the use of formal childcare (referred to as USE from hereafter). Employment participation in the IDS is provided only as months worked per year and hence LFP is defined

[84] Unemployment figures are included in the analysis since VATT estimates that 1% decrease in average unemployment rate increases the demand for childcare by 2,500 places.

as having worked at least one month a year either full-time, part-time or as an entrepreneur[85]. Sensitivity analysis is conducted using six months and twelve months as the cut-off points, however, this has no significant impact on the results[86]. Similarly, the binary variable for USE is 1 for those who have used any private or public childcare services.

The DD in the means of labour force participation is 4.1% in favour of the treatment region. As the theory predicted, the increased availability of childcare has therefore allowed more mothers to participate in the labour force. Also, the price of private childcare has decreased as expected by theory. Surprisingly, the price paid for public care has slightly increased according to these calculations. This may be due to higher use of public care by high-income families. Against all expectations the use of formal care has decreased.

Table 4.3: Simple difference-in-differences (IDS 1994-97)

	Control, G=0		*Treatment, G=1*		*DD*
	Before	*After*	*Before*	*After*	
Labour force participation	69.22%	69.65%	66.50%	71.02%	4.09%
Use of formal childcare	37.92%	44.94%	50.64%	53.72%	-3.94%
Payment for private care, €/month	171.92	195.79	236.83	218.55	-42.15
Payment for public care, €/month	121.75	126.14	141.17	159.07	13.51

Source: Income Distribution Survey

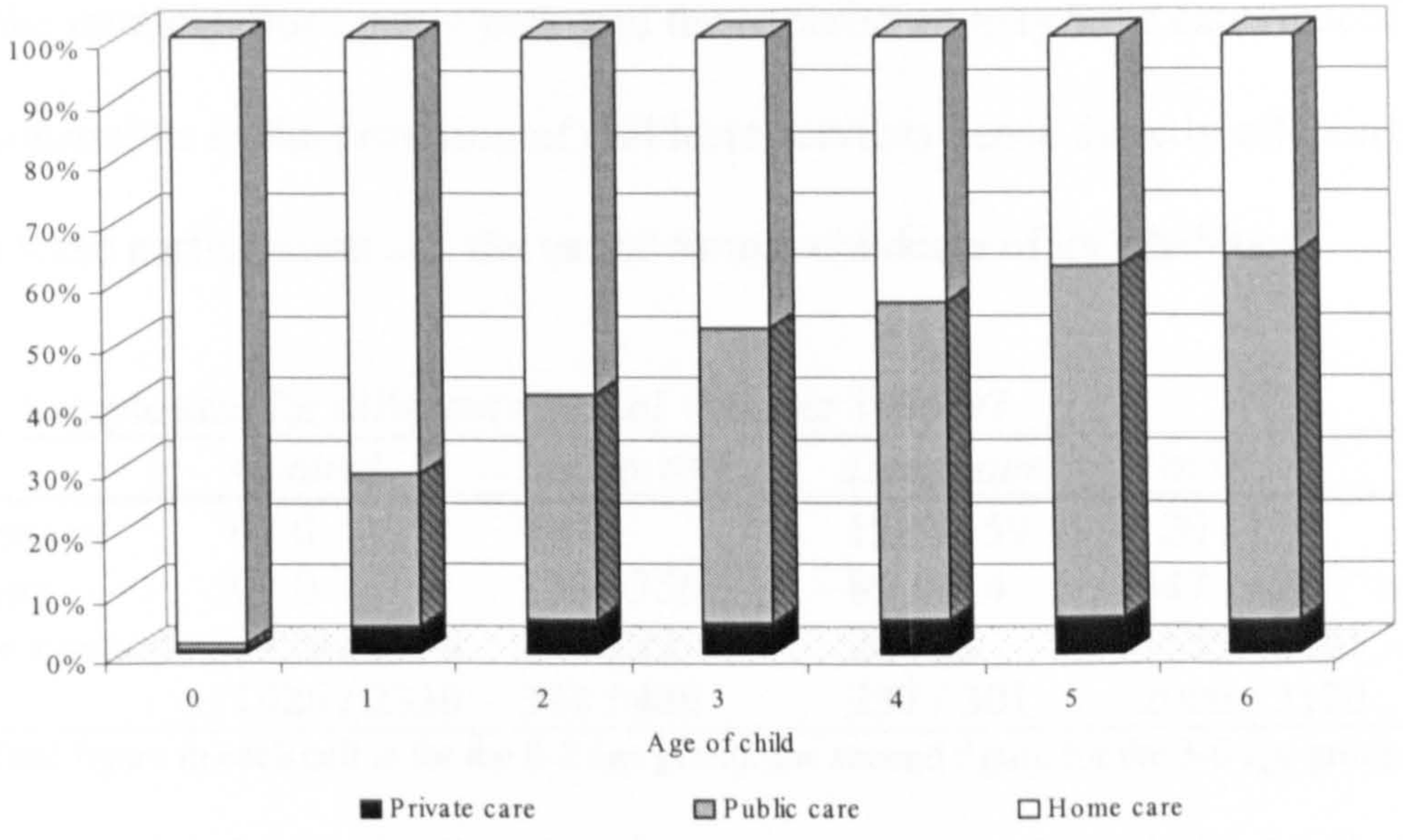
Note: "Before" refers to 1994 while "after" refers to the experimentation period 1995-97.

[85] The share of part-time employees is only slightly higher than 10% among female employees and hence no difference between full-time and part-time employment is taken into account in the estimation.

[86] The results are available from the author upon request.

It must be noted though that these simple DD calculations do not take into account any individual, regional or household characteristics. These controls are included in the analysis in the following sections.

Graph 4.1: Type of care used by child's age



Source: Income Distribution Survey

The family benefits and maternal and paternal leave are more generous for parents with children below three years old than for parents with older pre-school age children. In Graph 4.1, parental leave is included in the "home care" category. The kink in the budget constraint motivates the examination separately by the two age groups. Graph 4.1 shows that children below the age of three are most likely to be taken care of at home, usually by the mother. This may be due to parental preferences or even the financial support for home care as well as its

ease, and the job security provided by law (see Appendix 2 for details on the Finnish family policy including maternity leave legislation).

As mentioned in Section 4.4, the non-randomisation of the experiment at the municipality level may lead to threats to the validity of the DD estimates. For example, the municipalities participating in the experiment may have experienced resource constraints in the provision of childcare services hence directly affecting the labour force participation and the use of formal childcare of its inhabitants.

Table 4.4: Sample size for different types of voucher 1995-97

	Control	*Means test*	*Lump sum*	*Total*
Excess demand	0 / 0	0 / 0	120 / 159	120 / 159
Prerequisite	0 / 0	258 / 356	89 / 114	347 / 470
Rest of the country	1426 / 2330	85 / 133	28 / 28	1539 / 2491
Total	1426 / 2330	343 / 489	237 / 301	2006 / 3120

Note: First figure in each cell is for the 0-2 age group, the second figure for the 3-6 age group

Municipality level statistics for net childcare costs per capita, relative level of debt and long-run unemployment rate indicate that, on average, there are no significant differences in these variables between the treatment and control regions[87]. However, an examination of these statistics by the type of voucher reveals some differences between the municipalities. The sample sizes for 0-2 and 3-6 year olds by the type of voucher are reported separately in Table 4.4.

[87] These statistics are for the period immediately after the childcare voucher experiment and hence may not be a good indication of the situation before the start of the experiment. Statistics for the pre-experiment period are not available for this research.

Out of the 33 participants, 21 municipalities provided a means-tested voucher while the rest used a lump-sum voucher[88]. Besides the variation in the amount of the voucher, there are further differences in the type of voucher between municipalities. Thirteen municipalities adopted a voucher with a prerequisite for the parents to work or study to be eligible for the voucher. Such requirements to work or study do not exist as a prerequisite for the use of public childcare.

Furthermore, it is possible to identify three municipalities within the experiment region that suffer from excess demand for childcare (see Table 4.4 for sample sizes)[89]. Unfortunately, it is not possible to identify similar regions within the control regions due to data confidentiality reasons. However, this potential problem reduces the estimated coefficient hence providing us a lower bound estimate.

Municipalities with a means-tested (lump-sum) voucher had on average lower (higher) net childcare costs and long-run unemployment rate but also higher (lower) level of debt compared to the country average. Municipalities that had a prerequisite to work or study for the receipt of the voucher had on average slightly lower net childcare costs, significantly higher level of debt and lower level of long-run unemployment than the national average.

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[88] Municipalities adopting the means-tested voucher mostly use the payment schedules of public childcare.

[89] These municipalities are identified as suffering from excess demand for childcare by the Ministry for Social Affairs and Health in Finland in their publication "Lasten päivähoitoselvitys – syyskuu 1997".

To account for the possible selection of municipalities, we also estimate the voucher effect with propensity score matching. The propensity score matching estimation uses information from the period of experimentation (1995-1997) thus dropping the 1,525 additional observations from 1994 used in the DD analysis.

The matching methods include the nearest neighbour and the Epanechnikov kernel estimation with caliper/bandwidth values of 0.1, 0.01, and 0.005. The common support mostly holds without being too thin with any of the chosen caliper/bandwidth.

The propensity score is estimated with a probit where the covariates are mother's and father's age and their level of education, interaction of mother's and father's age, the household size, age of the youngest child, number and age of pre-school children, age of the pre-school age child interacted with father's and mother's age, interaction between the number of pre-school age children and the age of the youngest child, father's earnings, father's earnings interacted with the size of household, father's trade union status and year dummies.

4.6 Empirical results

The empirical analysis is conducted using the Finnish Income Distribution survey. The methods of analysis include difference-in-differences and propensity score matching. The results for the whole country are reported in section 4.6.1 while section 4.6.2 presents the analysis for parts of the country that experienced excess demand for childcare. Sections 4.6.3 through 4.6.5 examine different

types of vouchers adopted throughout the country, for example, a lump-sum or a means-tested voucher.

4.6.1 Whole experiment

Tables 4.5 and 4.6 show the impact of the private childcare voucher experiment, respectively, on the work and the use of formal childcare behaviour of mothers of young children using DD analysis. The propensity score matching estimates are presented in Table 4.7.

Table 4.5: DD estimates for labour force participation (whole sample)

	Model 1 *Age 0-2*		*Model 2* *Age 0-2*		*Model 3* *Age 3-6*		*Model 4* *Age 3-6*	
G×T	0.049 (0.059)		0.021 (0.054)		0.046 (0.046)		0.045 (0.041)	
G	-0.011 (0.052)		-0.009 (0.055)		-0.036 (0.040)		-0.086 (0.040)	**
T	-0.008 (0.030)		-0.156 (0.092)	*	0.006 (0.023)		-0.069 (0.065)	
Age			0.095 (0.028)	***			0.048 (0.022)	**
Age²/100			-0.135 (0.043)	***			-0.063 (0.031)	**
No. of children <7			-0.095 (0.020)	***			-0.066 (0.018)	***
Age of youngest child			0.009 (0.013)				0.045 (0.006)	***
Size of household			-0.026 (0.013)	**			-0.040 (0.009)	***
Baccalaureate			0.098 (0.040)	**			0.136 (0.030)	***
Baccalaureate plus vocational			0.175 (0.042)	***			0.170 (0.031)	***
Bachelors			0.242 (0.058)	***			0.249 (0.038)	***
Masters and above			0.433 (0.049)	***			0.319 (0.036)	***
Cities			-0.059 (0.048)				-0.126 (0.037)	***
Densely populated			-0.034 (0.048)				-0.062 (0.038)	
Rural			0.004 (0.054)				-0.045 (0.041)	
Constant	0.596 (0.026)	***	-1.419 (0.469)	***	0.756 (0.020)	***	-0.491 (0.391)	
R^2	0.001		0.138		0.001		0.190	
N	2,618		2,618		4,033		4,033	

Note: Standard errors in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Model (1) estimates the probability of working for mothers of the 0-2 age group and model (2) is the same as (1) with controls for individual characteristics displayed as well as father's age and its square, dummies for father's level of education, trend and its square, regional dummies (NUTS3) and regional unemployment rate.
Model (3) estimates the probability of working for mothers of the 3-6 age group and model (4) is the same as (3) with controls for individual characteristics displayed as well as father's age and its square, dummies for father's level of education, trend and its square, regional dummies (NUTS3) and regional unemployment rate.

In Table 4.5, the childcare voucher experiment is estimated for a sample of mothers with 0-2 years old children (columns 1 and 2) and 3-6 year old children (columns 3 and 4). Models (2) and (4) include controls for individual characteristics. Column (1) of the table shows the raw differential between the control and the treatment region to be 4.9 percentage points but this coefficient estimate is not significantly different from zero. Controlling for individual and regional characteristics in Column (2) of Table 4.6 reduces the effect of the voucher to 2.1 percentage points, still not significant.

The results are larger but still insignificant for mothers of children aged between 3 and 6 years. Otherwise both models perform well at explaining the LFP decision of mothers of young children. Older and more educated mothers are more likely to work. The size of the household and, in particular, the number of pre-school age children capture the economies of scale experienced with many children or a possible lower preference for work for mothers of young children.

These somewhat disappointing results tell us that the availability of a private childcare voucher did not have any impact on the LFP rates of mothers of pre-school age children. However, this is not completely unexpected since the municipalities themselves provide high-quality low-cost childcare. Hence unless the municipality is constrained in its provision of childcare the private care voucher is expected to have only a small effect on the LFP rates.

Table 4.6 reports the estimates of the impact of the private childcare voucher experiment on USE. The results indicate no significant effect for USE for either age group. The other covariates indicate that the probability of using formal childcare rises with the level of education. This is expected since for the highly educated group, the actual wage net of childcare costs is more likely to be higher than the reservation wage. The probability of using non-maternal care rises also with the age of the youngest child indicating either a higher preference for taking care of the younger children or a different budget constraint for the mothers of younger children due to, for example, a higher cost of childcare or higher level of financial support from the government. The population density dummies are only significant for the older age group children, likewise for the mother's age and the total number of pre-school age children.

Table 4.6: DD estimates for use of formal care (whole sample)

	Model 1 *Age 0-2*		*Model 2* *Age 0-2*		*Model 3* *Age 3-6*		*Model 4* *Age 3-6*	
G×T	-0.035 (0.050)		-0.034 (0.045)		-0.021 (0.048)		-0.031 (0.044)	
G	0.098 (0.044)	**	0.051 (0.046)		0.150 (0.043)	***	0.007 (0.044)	
T	0.038 (0.024)		-0.141 (0.071)	**	0.082 (0.026)	***	-0.041 (0.072)	
Age			0.012 (0.022)				0.082 (0.023)	***
Age²/100			-0.022 (0.033)				-0.111 (0.032)	***
No. of children <7			-0.006 (0.014)				-0.054 (0.017)	***
Age of youngest child			0.204 (0.010)	***			-0.043 (0.006)	***
Size of household			-0.036 (0.010)	***			-0.055 (0.009)	***
Baccalaureate			0.036 (0.031)				0.130 (0.030)	***
Baccalaureate plus vocational			0.084 (0.033)	***			0.178 (0.032)	***
Bachelors			0.102 (0.046)	**			0.280 (0.042)	***
Masters and above			0.232 (0.040)	***			0.305 (0.039)	***
Cities			-0.002 (0.040)				-0.104 (0.040)	***
Densely populated			-0.002 (0.040)				-0.171 (0.041)	***
Rural			-0.054 (0.043)				-0.272 (0.044)	***
Constant	0.216 (0.020)	***	-0.705 (0.366)	*	0.488 (0.023)	***	-0.748 (0.405)	*
R^2	0.006		0.220		0.018		0.231	
N	2,618		2,618		4,033		4,033	

Note: Standard errors in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Model (1) estimates the probability of using formal childcare for the 0-2 age group and model (2) is the same as (1) with controls for individual characteristics displayed as well as father's age and its square, dummies for father's level of education, trend and its square, regional dummies (NUTS3) and regional unemployment rate.
Model (3) estimates the probability of using formal childcare for the 3-6 age group and model (4) is the same as (3) with controls for individual characteristics displayed as well as father's age and its square, dummies for father's level of education, trend and its square, regional dummies (NUTS3) and regional unemployment rate.

The non-significant results of the experiment on USE may seem counter-intuitive especially since Heikkilä and Törmä (1996) report that 55% of the families who chose the private childcare voucher were new customers to the private sector care.

Table 4.7: Propensity score matching estimates for labour force participation and use of formal care (whole sample)

	Labour force participation		*Use of formal care*		
	Age 0-2	*Age 3-6*	*Age 0-2*	*Age3-6*	
Nearest Neighbour, caliper 0.1	-0.012	-0.006	0.043	0.055	*
	(0.034)	(0.027)	(0.037)	(0.030)	
	[99.83%]	[99.24%]	[99.83%]	[99.24%]	
	{104}	{193}	{104}	{193}	
Nearest Neighbour, caliper 0.01	-0.012	-0.006	0.035	0.057	*
	(0.036)	(0.028)	(0.036)	(0.031)	
	[97.24%]	[97.72%]	[97.24%]	[97.72%]	
	{108}	{188}	{108}	{188}	
Nearest Neighbour, caliper 0.005	-0.011	-0.011	0.033	0.054	*
	(0.036)	(0.028)	(0.036)	(0.031)	
	[95.17%]	[95.82%]	[95.17%]	[95.82%]	
	{108	{176}	{108}	{176}	
Epanechnikov kernel,bandwidth 0.1	-0.009	-0.009	0.017	0.061	***
	(0.023)	(0.018)	(0.026)	(0.020)	
Epanechnikov kernel,bandwidth 0.01	-0.014	-0.008	0.009	0.055	***
	(0.024)	(0.020)	(0.027)	(0.020)	
Epanechnikov kernel, bandwidth 0.005	-0.012	-0.005	0.014	0.055	**
	(0.026)	(0.020)	(0.028)	(0.021)	
Observations	2,006	3,120	2,006	3,120	
Of which treated	580	790	580	790	

Note: Standard errors reported in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Standard errors obtained by bootstrapping (500 replications for nearest neighbour kernel; 100 replications for Epanechnikov kernel).
Percentage of treated observations matched to a control observation in square brackets.
Number of control observations responsible for 50% of matches in curly brackets.

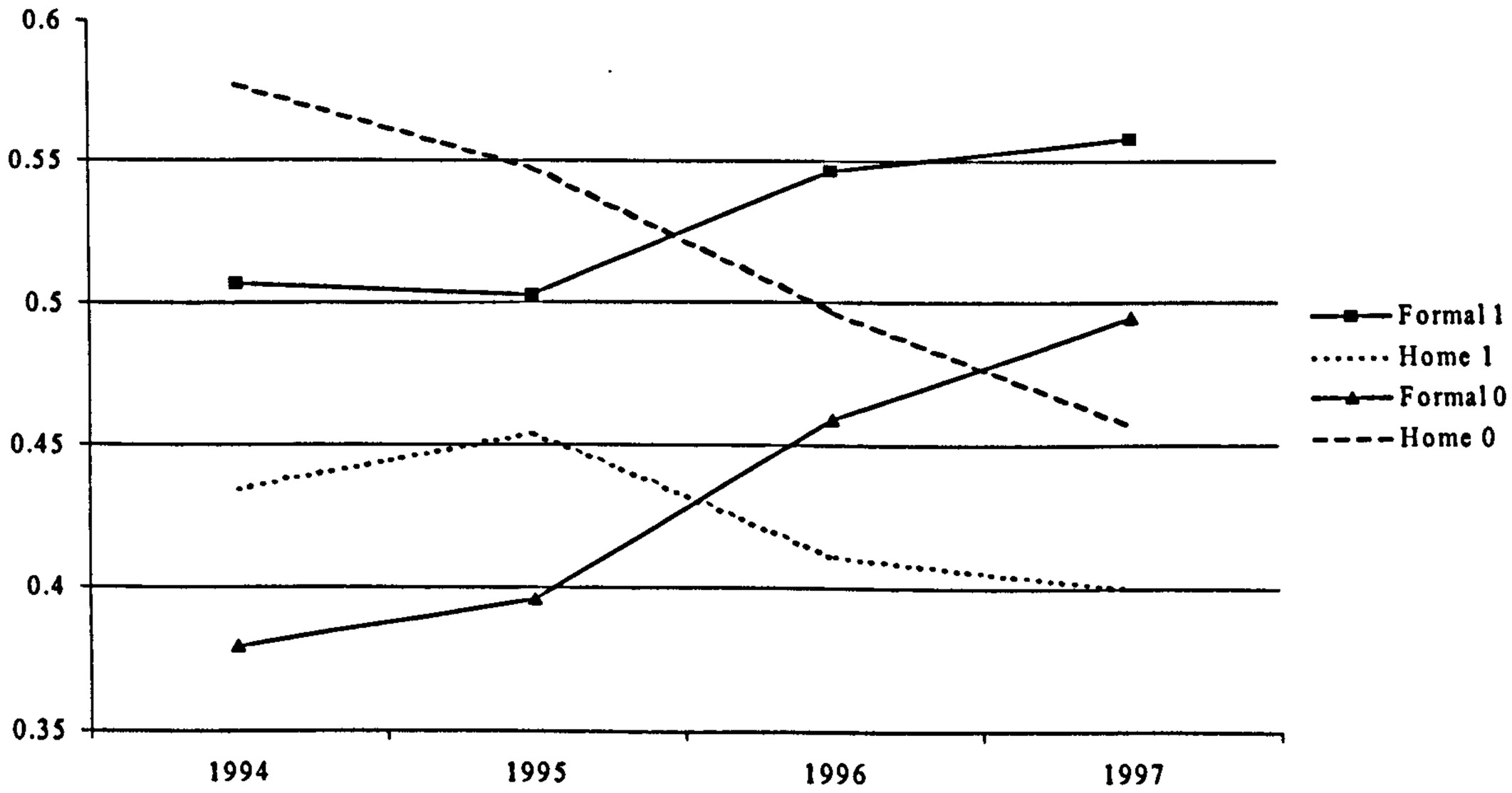
Table 4.7 reports propensity score matching estimates of the impact of the private childcare voucher for the whole country sample. Nearest neighbour matches are reported with a caliper of 0.1, 0.01 and 0.005. Similarly, kernel estimates use a bandwidth of 0.1, 0.01 and 0.005. As indicators of match quality, the table reports the proportion of matched treated observations (with nearest neighbour) and, as an indicator of the thickness of the common support, the number of control observations accounting for 50% of the matches. When a few controls are used several times, the precision of the estimates suffers (Abadie and Imbens, 2001). Standard errors are obtained by bootstrap with 500 or 100 replications depending on the kernel.

None of the estimates for the younger age group are significant. On the other hand, for the older age group the use of formal childcare has increased as a result of the experiment. The nearest neighbour kernel gives a three percentage point increase for the use of formal childcare, while using the Epanechnikov kernel the impact increases to 6 percentage points. The Epanechnikov kernel is our preferred specification since it uses more control observations and throughout results in lower standard errors. A large proportion of the treated are matched, however, even the largest caliper/bandwidth does not result in a 100% matching accuracy.

It must be noted that the propensity score matching results are very different from the previously estimated DD results. This may indicate the importance of

relaxing the assumption of linear functional form inherent to OLS estimation. Furthermore, DD assumes that there is a fixed difference in the level of outcome between the treated and the control group observations prior to the experiment as well as a fixed difference after the start of the experiment equalling the previous fixed difference plus the impact of the treatment on the treated. Graph 4.2 shows that this assumption may not hold for the use of formal since the rate of growth differs between the treatment and the control group.

Graph 4.2: Proportion of users of informal and formal childcare



Source: Income Distribution Survey
Note: 1 for experiment region; 0 for control region

4.6.2 Areas of excess demand

Municipalities that experience excess demand for childcare are expected to exhibit a positive impact of the voucher on the labour force participation rates since expanding the market for childcare, the private childcare voucher would

release previously non-employed mothers to work. In the data it is possible to identify three municipalities within the experiment region that experienced excess demand for childcare prior to the voucher experiment. The following analysis includes these three municipalities as the treated while the non-experimental municipalities provide a control group as previously (see Table 4.4 for sample sizes).

Columns 1 and 2 of Table 4.8 provide estimates of the impact of the private childcare voucher for LFP in areas of excess demand versus the control region. Controlling for individual, household and regional characteristics, the impact of the voucher on employment is not significant for either age group. On the other hand, column 4 shows that the mothers of 3-6 year old children were 31.2 percentage points less likely to use formal childcare as a result of the private childcare voucher availability. It is reasonable to expect that the private care voucher would relieve the shortage of supply and therefore increase the use of formal childcare. This unexpected negative result is highly significant, however, it may be seriously biased due to initial differences between the two regions and possibly the failing assumption of linearity.

Table 4.8: DD estimates for labour force participation and use of formal care (areas of excess demand)

	Labour force participation				*Use of formal care*			
	Age0-2		*Age 3-6*		*Age 0-2*		*Age3-6*	
G×T	0.220		-0.090		0.019		-0.312	***
	(0.143)		(0.101)		(0.124)		(0.115)	
G	-0.160		0.004		0.040		0.285	***
	(0.125)		(0.087)		(0.115)		(0.101)	
T	-0.153		-0.092		-0.122		-0.043	
	(0.106)		(0.075)		(0.080)		(0.082)	
Age	0.070	**	0.032		0.005		0.077	***
	(0.032)		(0.025)		(0.024)		(0.025)	
Age²/100	-0.115	**	-0.069	**	-0.013		-0.101	***
	(0.046)		(0.033)		(0.037)		(0.035)	
No. of children <7	-0.076	***	-0.052	**	0.007		-0.055	***
	(0.023)		(0.021)		(0.015)		(0.020)	
Age of youngest child	0.013		0.045	***	0.180	***	0.040	***
	(0.015)		(0.007)		(0.012)		(0.008)	
Size of household	-0.032	**	-0.044	***	-0.042	***	-0.061	***
	(0.014)		(0.010)		(0.010)		(0.010)	
Baccalaureate	0.104	**	0.157	***	0.028		0.178	***
	(0.045)		(0.034)		(0.033)		(0.033)	
Bac plus vocational	0.203	***	0.191	***	0.103	***	0.234	***
	(0.048)		(0.036)		(0.036)		(0.037)	
Bachelors	0.198	***	0.236	***	0.045		0.348	***
	(0.070)		(0.046)		(0.051)		(0.049)	
Masters and above	0.413	***	0.317	***	0.236	***	0.315	***
	(0.059)		(0.043)		(0.048)		(0.049)	

Table 4.8 continued

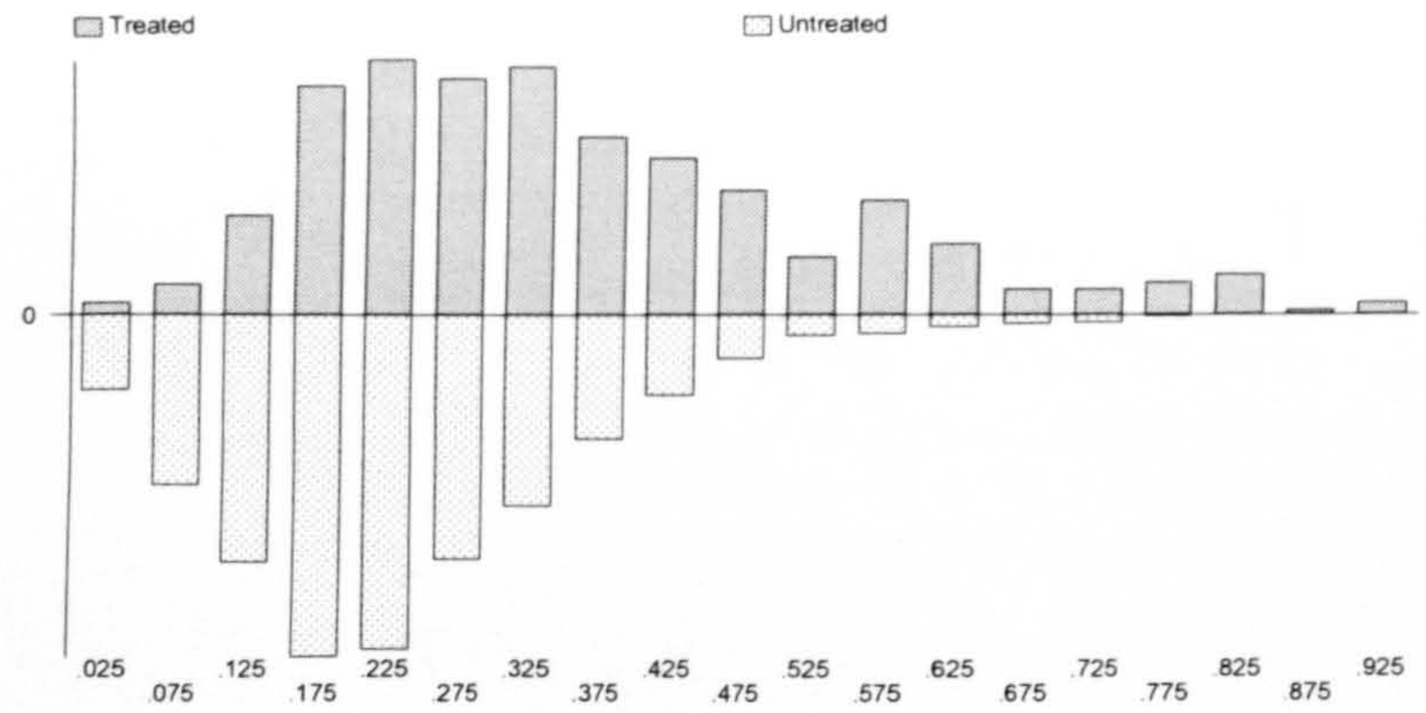
	Labour force participation				*Use of formal care*			
	Age0-2		*Age 3-6*		*Age 0-2*		*Age3-6*	
Cities	-0.220		0.226		-0.252		-0.263	***
	(0.221)		(0.159)		(0.179)		(0.084)	
Densely populated	-0.189		0.302	*	-0.262		-0.325	***
	(0.221)		(0.159)		(0.179)		(0.086)	
Rural	-0.145		0.317	**	-0.303	*	-0.431	***
	(0.222)		(0.159)		(0.179)		(0.086)	
Constant	-1.110	**	-1.098	**	-0.230		-0.701	
	(0.562)		(0.472)		(0.434)		(0.448)	
R^2	0.132		0.191		0.211		0.236	
N	1,937		3,106		1,937		3,106	

Note: Standard errors in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Regressions include controls for father's age and its square, dummies for father's level of education, trend and its square, regional dummies (NUTS3) and regional unemployment rate.

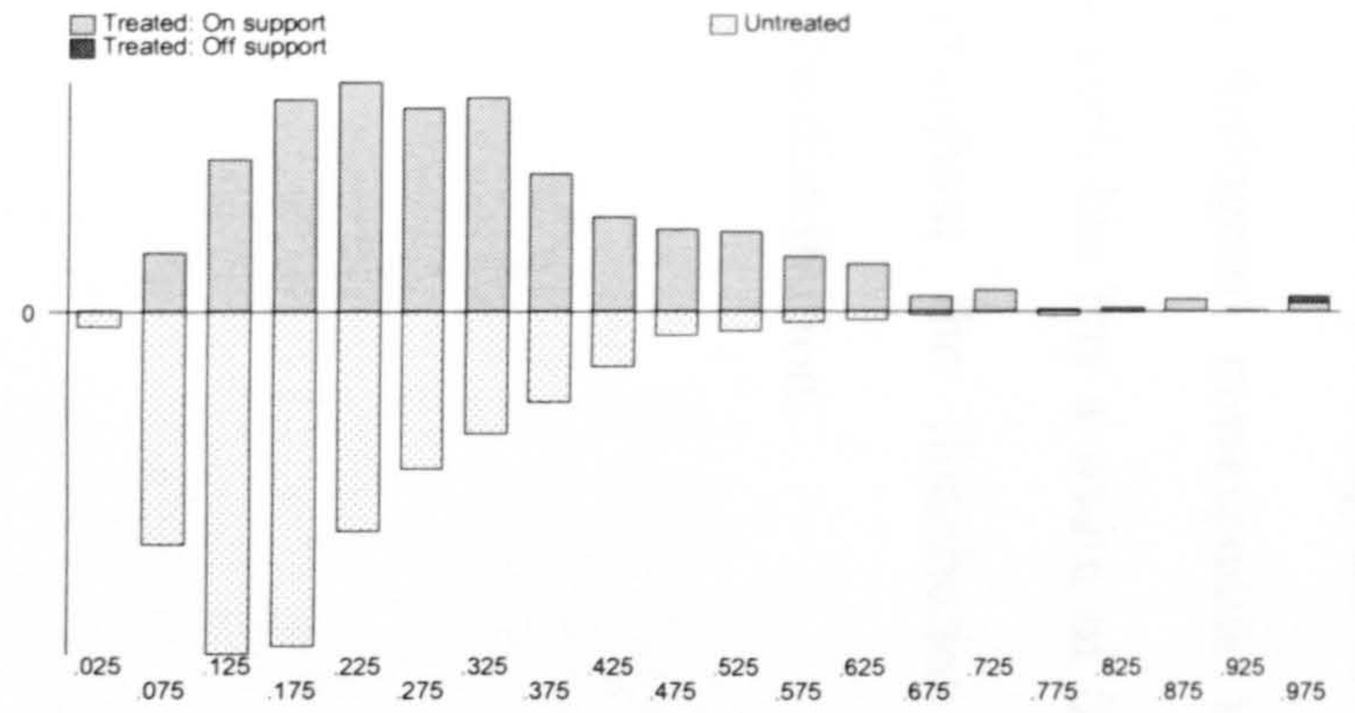
Table 4.9 reports the results of propensity score matching using both the nearest neighbour matching estimator and the Epanechnikov kernel matching estimator. The results in Table 4.9 give the impact of the private childcare voucher on LFP of the treated group in the areas that experienced excess demand for childcare. The results are reported separately for the mothers of children aged between 0-2 and 3-6. The distributions of propensity scores are reported in Figure 4.3.

Figure 4.3: Distribution of propensity scores (areas of excess demand)

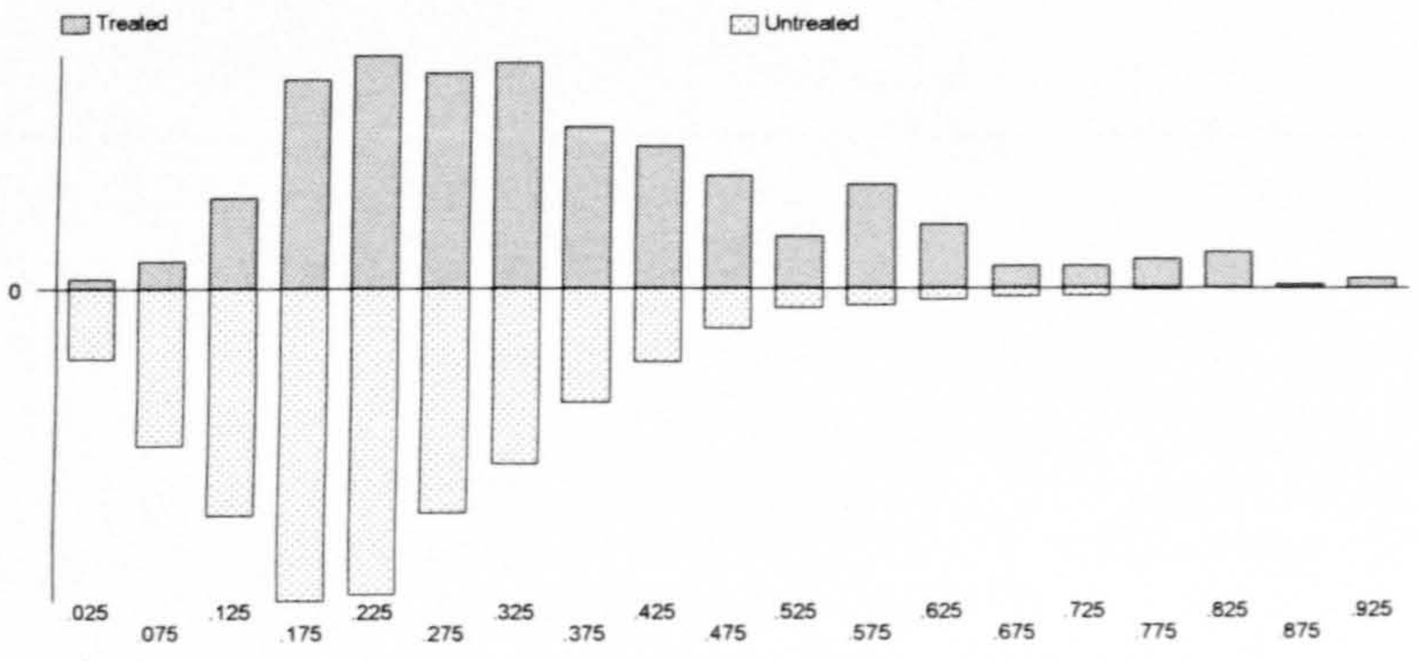
Work, mothers of 0-2 year olds



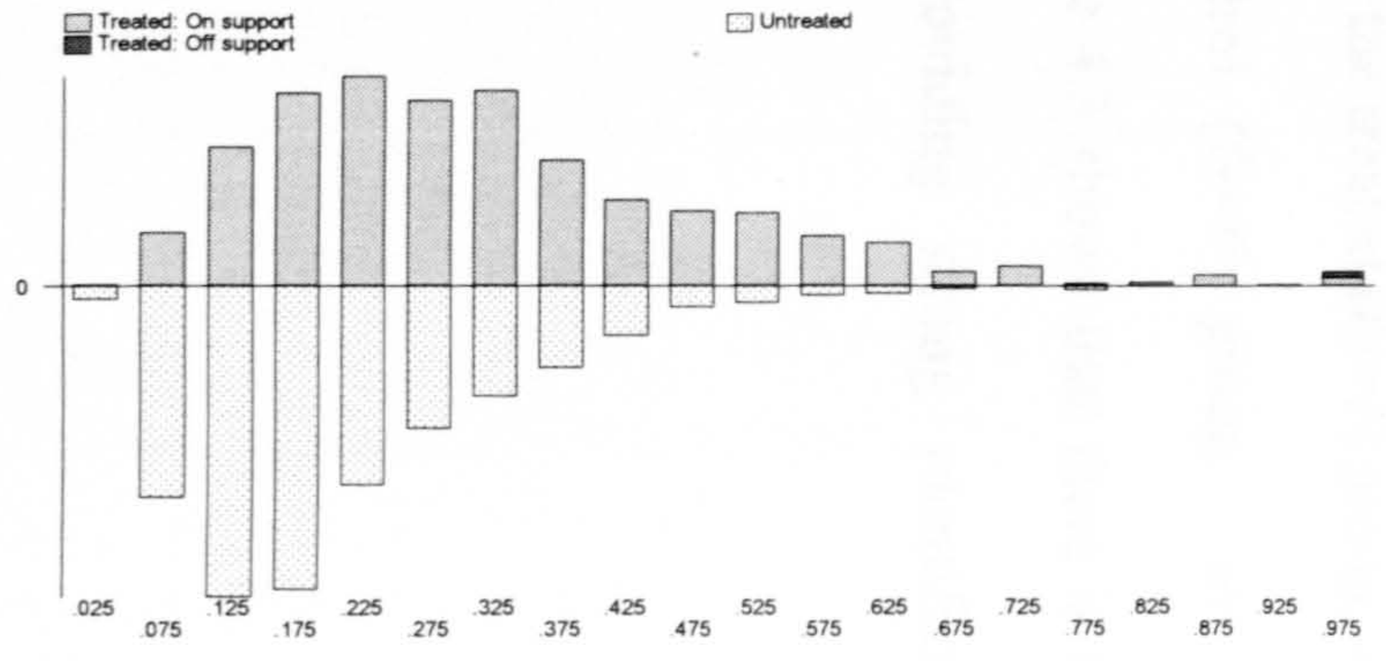
Work, mothers of 3-6 year olds



Use of formal care, mothers of 0-2 year olds



Use of formal care, mothers of 3-6 year olds



In Figure 4.3, the top histogram corresponds to the treated ($G=1$) group, while the bottom histogram corresponds to the control ($G=0$) group. In these histograms, each bin has a width of 0.05. Figure 4.3 shows that there is thick support throughout the distribution hence providing strong identification throughout the distribution.

Table 4.9: Propensity score matching estimates for labour force participation and use of formal care (areas of excess demand)

	Labour force participation			*Use of formal care*		
	Age0-2	*Age 3-6*		*Age 0-2*	*Age3-6*	
Nearest Neighbour, caliper 0.1	-0.033	0.065	*	-0.033	0.136	***
	(0.041)	(0.036)		(0.054)	(0.041)	
	[100%]	[100%]		[100%]	[100%]	
	{58}	{88}		{58}	{88}	
Nearest Neighbour, caliper 0.01	-0.018	0.068	*	-0.018	0.138	***
	(0.044)	(0.037)		(0.050)	(0.041)	
	[95.32%]	[95.45%]		[95.32%]	[95.45%]	
	{57}	{83}		{57}	{83}	
Nearest Neighbour, caliper 0.005	-0.035	0.056 (0.037)		-0.035	0.138	***
	(0.046)	[92.93%]		(0.049)	(0.042)	
	[93.65%]	{89}		[93.65%]	[92.93%]	
	{64}			{64}	{89}	
Epanechnikov kernel,bandwidth 0.1	0.018	0.052	**	0.031	0.149	***
	(0.031)	(0.024)		(0.042)	(0.027)	
Epanechnikov kernel,bandwidth 0.01	0.036	0.052 (0.025)	**	0.046	0.135	***
	(0.036)			(0.043)	(0.029)	
Epanechnikov kernel,bandwidth 0.005	0.029	0.038 (0.026)		0.034	0.136	***
	(0.036)			(0.039)	(0.030)	
Observations	1,721	2,718		1,721	2,718	
Of which treated	299	396		299	396	

Note: Standard errors reported in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Standard errors obtained by bootstrapping (500 replications for nearest neighbour kernel; 100 replications for Epanechnikov kernel).
Percentage of treated observations matched to a control observation in square brackets.
Number of control observations accounting for 50% of match in curly brackets.

The results for the 0-2 year olds are insignificant both with respect to USE and LFP (see the first and third columns of Table 4.9). The second and fourth columns of Table 4.9 report the impact of the private childcare voucher on LFP and USE for the mothers of 3-6 year old children. The DD results reported in Table 4.8 showed a significant negative impact of over 30 percentage points on USE. The estimates using the propensity score matching are positive both for LFP and USE. First, the nearest neighbour kernel indicates about a 6.5 percentage point increase in the likelihood of working, however, this result is only marginally significant. On the other hand, the Epanechnikov kernel estimate is slightly lower at 5.2 percentage points but this estimate is highly significant. As predicted by the theory, kernel matching reduces the variance of estimates.

The results of the voucher experiment in areas of excess demand for the use of formal childcare for the 3-6 year olds show over 13 percentage point effect regardless of the kernel or the caliper/bandwidth. In general, a tighter caliper/bandwidth reduces the estimates slightly or leaves them unchanged. With the larger bandwidth, there is no problem of common support and all treated observations are matched.

All the results for the older age group in areas of excess demand are highly significant for USE. The results are slightly weaker for LFP, especially with a bandwidth/caliper of 0.005. However, the matching accuracy is reduced

considerably with the smallest bandwidth/caliper with only 92.93% of the treated being matched to a control group observation.

The distinction between the results of the different age groups is as expected due to differences in the municipalities requirements for the provision of childcare places. Since 1990 the municipalities have faced a legal requirement to provide a childcare place for every 0-2 year old who needs a place. Hence the municipalities have had time to expand the provision for the younger age group. Municipalities had no requirement to give a universal access to the 3-6 year olds until 1996. Therefore this age group might have formed the bulk of the queue for childcare in the areas of excess demand for childcare.

Another potential explanation lies in the differences between public and private care. In general, private childcare is more specialised. It might therefore appeal to some mothers with a high valuation of specialised care who previously took care of the children themselves. Private care also offers more flexibility in opening hours, which facilitates combining childcare and a career. Furthermore, mothers of older children are in general more likely to participate in the labour force.

4.6.3 Voucher with a prerequisite

The type of voucher varies within the experiment region. This and the following two sections examine the impact of the different types of vouchers on

LFP and USE[90]. The estimation methods include DD and propensity score matching[91] as before.

Thirteen municipalities adopted a private childcare voucher where as a prerequisite for eligibility, the mother had to be in employment or in education. These 13 municipalities form the treatment group while the control group includes the municipalities not adopting a childcare voucher (see sample sizes in Table 4.4).

The type of voucher that has this prerequisite of working or studying has a positive impact on LFP and a negative impact on USE, both of which are insignificant, as shown in Table 4.10 using the DD estimation.

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[90] We do not account for the potential endogeneity of the voucher type at the municipality level in this analysis.

[91] The sample is restricted to include the voucher type as the treatment region while the control group is unchanged compared to the previous difference-in-differences analysis.

Table 4.10: DD estimates for labour force participation and use of formal care (areas with a prerequisite)

	Labour force participation				*Use of formal care*			
	Age0-2		*Age 3-6*		*Age 0-2*		*Age3-6*	
G×T	-0.009		0.021		-0.014		-0.067	
	(0.065)		(0.050)		(0.054)		(0.052)	
G	0.003		-0.049		-0.018		0.026	
	(0.066)		(0.051)		(0.054)		(0.053)	
T	-0.141		-0.050		-0.135	*	-0.041	
	(0.098)		(0.069)		(0.074)		(0.075)	
Age	0.075	**	0.053	**	0.005		0.082	***
	(0.030)		(0.024)		(0.022)		(0.023)	
Age²/100	-0.105	**	-0.071	**	0.001		-0.111	***
	(0.045)		(0.033)		(0.034)		(0.032)	
No. of children <7	-0.085	***	-0.062	***	0.004		-0.055	***
	(0.021)		(0.019)		(0.015)		(0.018)	
Age of youngest child	0.012		0.046	***	0.196	***	0.044	***
	(0.014)		(0.006)		(0.011)		(0.007)	
Size of household	-0.027	**	-0.039	***	-0.040	***	-0.055	***
	(0.014)		(0.010)		(0.010)		(0.009)	
Baccalaureate	0.109	***	0.136	***	0.035		0.149	***
	(0.041)		(0.031)		(0.031)		(0.031)	
Bac plus vocational	0.175	***	0.163	***	0.080	**	0.190	***
	(0.043)		(0.033)		(0.034)		(0.034)	
Bachelors	0.258	***	0.241	***	0.091	*	0.317	***
	(0.061)		(0.041)		(0.048)		(0.044)	
Masters and above	0.436	***	0.311	***	0.227	***	0.295	***
	(0.051)		(0.038)		(0.043)		(0.042)	

Table 4.10 continued

	Labour force participation				*Use of formal care*			
	Age0-2		*Age 3-6*		*Age 0-2*		*Age3-6*	
Cities	-0.112	*	-0.116	***	-0.084	*	-0.193	***
	(0.059)		(0.045)		(0.049)		(0.047)	
Densely populated	-0.080		-0.037		-0.094	*	-0.254	***
	(0.065)		(0.050)		(0.053)		(0.053)	
Rural	-0.031		-0.020		-0.137	***	-0.359	***
	(0.066)		(0.050)		(0.052)		(0.052)	
Constant	-1.283	***	-0.656		-0.593		-0.693	*
	(0.488)		(0.419)		(0.379)		(0.417)	
R^2	0.136		0.186		0.215		0.239	
N	2,325		3,612		2,325		3,612	

Note: Standard errors in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Regressions include controls for father's age and its square, dummies for father's level of education, trend and its square, regional dummies (NUTS3) and regional unemployment rate.

Table 4.11 reports the impact of a voucher with a prerequisite to work or study using propensity score matching. Column 1 for the 0-2 year olds shows a negative effect of the voucher on LFP, however, all of these estimates are insignificant. However, for mothers of older children a significant negative result on participation is obtained. A voucher with a working requirement reduces LFP by about 7.7 percentage points, which is highly significant using the nearest neighbour kernel.

Table 4.11: Propensity score matching estimates for labour force participation and use of formal care (areas with a prerequisite)

	Labour force participation			*Use of formal care*		
	Age 0-2	*Age 3-6*		*Age 0-2*	*Age 3-6*	
Nearest Neighbour, caliper 0.1	-0.006	-0.077	***	0.023	0.053	
	(0.043)	(0.030)		(0.041)	(0.038)	
	[100%]	[100%]		[100%]	[100%]	
	{86}	{122}		{86}	{122}	
Nearest Neighbour, caliper 0.01	-0.006	-0.076	**	0.012	0.058	
	(0.044)	(0.030)		(0.041)	(0.038)	
	[97.69%]	[98.51%]		[97.69%]	[98.51%]	
	{89}	{125}		{89}	{125}	
Nearest Neighbour, caliper 0.005	0.000	-0.077	**	0.027	0.057	
	(0.046)	(0.031)		(0.041)	(0.039)	
	[95.39%]	[96.81%]		[95.39%]	[96.81%]	
	{92}	{127}		{92}	{127}	
Epanechnikov kernel, bandwidth 0.1	-0.011	-0.014		0.009	0.084	***
	(0.029)	(0.023)		(0.028)	(0.025)	
Epanechnikov kernel, bandwidth 0.01	-0.038	-0.031		0.004	0.065	**
	(0.033)	(0.025)		(0.029)	(0.027)	
Epanechnikov kernel, bandwidth 0.005	-0.032	-0.035		0.023	0.062	**
	(0.036)	(0.026)		(0.029)	(0.027)	
Observations	1,773	2,800		1,773	2,800	
of which treated	347	470		347	470	

Note: Standard errors reported in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Standard errors obtained by bootstrapping (500 replications for nearest neighbour kernel; 100 replications for Epanechnikov kernel).
Percentage of treated observations matched to a control observation in square brackets.
Number of control observations accounting for 50% of match in curly brackets.

The coefficient estimate is negative as expected since requirements to work or study to obtain childcare place do not exist for publicly provided childcare. Furthermore, due to the municipality's legal requirement to provide a childcare place for children aged 0-2, parents have no incentive to use private care if it imposes any requirements. Similarly, this pre-requirement increases the cost of obtaining the voucher, for example, the search costs for employment are higher for parents of young children. Hence, one may expect a negative impact of the voucher on mother's participation.

The voucher with a prerequisite to work or study results in positive significant effects on USE for the older age group children ranging between 6.2 and 8.4 percentage points depending on the bandwidth used. The corresponding nearest neighbour estimates are not significant. The positive coefficient is as expected, however, proves slightly peculiar combined with the negative impact on LFP. This combination is feasible if most of the increase in USE is experienced in public childcare sector. The raw data confirms this with an increase of 10.6 percentage points in public care while private care decreased by 1.4 percentage points between 1994 and 1997.

4.6.4 Lump-sum voucher

A lump-sum voucher was adopted in six municipalities. The lump-sum voucher is on average of higher value than the means-tested voucher (see Table 4.14 for further details) for both age groups, however, since the distribution of the

means-tested voucher is unknown we cannot draw any conclusions on the expected impact of the lump-sum versus means-tested voucher on the dependent variables of interest.

Table 4.12: DD estimates for labour force participation and use of formal care (areas with a lump sum voucher)

	Labour force participation				*Use of formal care*			
	Age0-2		*Age 3-6*		*Age 0-2*		*Age3-6*	
G×T	-0.012		0.043		-0.115	*	-0.001	
	(0.074)		(0.063)		(0.062)		(0.068)	
G	0.015		-0.115	*	0.094		-0.007	
	(0.075)		(0.061)		(0.062)		(0.067)	
T	-0.158		-0.076		-0.120		-0.044	
	(0.100)		(0.072)		(0.075)		(0.078)	
Age	0.082	***	0.043	*	0.009		0.085	***
	(0.031)		(0.024)		(0.023)		(0.025)	
Age²/100	-0.114	**	-0.053		-0.012		-0.114	***
	(0.047)		(0.033)		(0.036)		(0.035)	
No. of children <7	-0.091	***	-0.056	***	0.004		-0.050	***
	(0.022)		(0.020)		(0.015)		(0.019)	
Age of youngest child	0.009		0.047	***	0.193	***	0.042	***
	(0.014)		(0.007)		(0.011)		(0.007)	
Size of household	-0.029	**	-0.043	***	-0.041	***	-0.063	***
	(0.014)		(0.010)		(0.010)		(0.009)	
Baccalaureate	0.092	**	0.134	***	0.032		0.162	***
	(0.044)		(0.033)		(0.032)		(0.032)	
Bac plus vocational	0.201	***	0.167	***	0.110	***	0.216	***
	(0.046)		(0.035)		(0.035)		(0.035)	
Bachelors	0.202	***	0.237	***	0.103	**	0.344	***
	(0.065)		(0.043)		(0.049)		(0.046)	
Masters and above	0.414	***	0.313	***	0.239	***	0.329	***
	(0.055)		(0.041)		(0.044)		(0.045)	

Table 4.12 continued

	Labour force participation		*Use of formal care*	
	Age0-2	*Age 3-6*	*Age 0-2*	*Age3-6*
Cities	-0.065	-0.125 **	-0.001	-0.027
	(0.070)	(0.057)	(0.058)	(0.061)
Densely populated	-0.024	-0.049	-0.003	-0.036
	(0.069)	(0.059)	(0.057)	(0.063)
Rural	0.027	-0.030	-0.048	-0.140 **
	(0.073)	(0.061)	(0.059)	(0.064)
Constant	-1.193 **	-0.658	-0.613	-0.968 **
	(0.506)	(0.428)	(0.382)	(0.436)
R^2	0.136	0.187	0.218	0.229
N	2,183	3,392	2,183	3,392

Note: Standard errors in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Regressions include controls for father's age and its square, dummies for father's level of education, trend and its square, regional dummies (NUTS3) and regional unemployment rate.

With DD estimation, a lump-sum voucher has a marginally significant negative impact on USE for the mothers of 0-2 year old children (see Table 4.12). Most of the coefficient estimates on both USE and LFP are negative but fail to be significant.

Table 4.13: Propensity score matching estimates for labour force participation and use of formal care (areas with a lump-sum voucher)

	Labour force participation		*Use of formal care*	
	Age 0-2	*Age 3-6*	*Age 0-2*	*Age 3-6*
Nearest Neighbour, caliper 0.1	-0.059	-0.048	-0.059	0.010
	(0.048)	(0.041)	(0.053)	(0.045)
	[100%]	[97.01%]	[100%]	[97.01%]
	{58}	{95}	{58}	{95}
Nearest Neighbour, caliper 0.01	-0.049	-0.045	-0.057	0.014
	(0.050)	(0.042)	(0.053)	(0.047)
	[95.78%]	[95.35%]	[95.78%]	[95.35%]
	{63}	{98}	{63}	{98}
Nearest Neighbour, caliper 0.005	-0.053	-0.047	-0.058	0.007
	(0.050)	(0.042)	(0.054)	(0.047)
	[95.36%]	[92.36%]	[95.36%]	[92.36%]
	{63}	{98}	{63}	{98}
Epanechnikov kernel, bandwidth 0.1	-0.037	-0.043 *	-0.009	0.023
	(0.032)	(0.026)	(0.037)	(0.031)
Epanechnikov kernel,bandwidth 0.01	-0.024	-0.047	-0.020	0.008
	(0.036)	(0.030)	(0.041)	(0.035)
Epanechnikov kernel, bandwidth 0.005	-0.033	-0.055 *	-0.024	0.002
	(0.038)	(0.030)	(0.040)	(0.034)
Observations	1,663	2,631	1,663	2,631
of which treated	237	301	237	301

Note: Standard errors reported in parentheses. *** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Standard errors obtained by bootstrapping (500 replications for nearest neighbour kernel; 100 replications for Epanechnikov kernel).
Percentage of treated observations matched to a control observation in square brackets.
Number of control observations accounting for 50% of match in curly brackets.

Table 4.13 reports the results of a lump-sum voucher using propensity score matching. Only marginally significant negative results are reported for LFP of mothers of 3-6 year old children (column two of Table 4.13) using the Epanechnikov kernel. However, even the widest bandwidth results in relatively worse rate of matching with 97% of the treated being matched.

One may expect a positive result for both LFP and USE since any type of voucher should increase the availability of childcare in the municipality. However, a negative coefficient is feasible considering that half of the observations in the lump sum regions also suffer from excess demand for public childcare services (see Table 4.4). Hence since the private care is likely to be more expensive with the lump sum voucher than public childcare, mothers may be discouraged from working without access to affordable care.

4.6.5 Means tested voucher

The means tested voucher was adopted in 21 municipalities. Over 70% of the observations in municipalities with a means tested voucher also have a prerequisite to work or study. This may reduce the estimated impact, however, not to the extent of the lump sum voucher since the maximum means tested voucher is higher in value. Unfortunately the data does not allow the examination of individual municipalities, or the value of the different types of voucher adopted.

Table 4.14: Average value of lump-sum vs. means-tested voucher

	Age 0-2	*Age 3-6*
Lump sum	304	263
Means-tested minimum	140	128
Means-tested maximum	366	343

Source: Own calculation using figures from Heikkilä and Törmä (1996)

Table 16 reports the DD estimates for LFP and USE in areas of excess demand separately for mothers of 0-2 and 3-6 year old children. The estimates for LFP are approximately 5 percentage points for both age groups, however, the estimates fail to be significant. The impact for USE is less consistent being positive for the younger age group and negative for the older age group, but both are insignificant.

Table 4.15: DD estimates (areas with a means-tested voucher)

	Labour force participation						*Use of formal care*					
	Age0-2			*Age 3-6*			*Age 0-2*			*Age3-6*		
G×T	0.049			0.050			0.028			-0.039		
	(0.067)			(0.049)			(0.058)			(0.051)		
G	-0.006			-0.061			0.031			-0.005		
	(0.071)			(0.049)			(0.062)			(0.052)		
T	-0.146			-0.077			-0.158	**		-0.038		
	(0.098)			(0.068)			(0.075)			(0.075)		
Age	0.086	***		0.039	*		0.004			0.076		***
	(0.029)			(0.024)			(0.023)			(0.023)		
Age²/100	-0.117	***		-0.051			-0.009			-0.103		***
	(0.044)			(0.033)			(0. 034)			(0.032)		
No. of children <7	-0.088	***		-0.065	***		-0.006			-0.056		***
	(0.021)			(0.018)			(0.014)			(0.018)		
Age of youngest child	0.012			0.044	***		0.197	***		0.042		***
	(0.014)			(0.006)			(0.011)			(0.007)		
Size of household	-0.025	*		-0.039	***		-0.036	***		-0.053		***
	(0.014)			(0.009)			(0.010)			(0.009)		
Baccalaureate	0.115	***		0.153	***		0.029			0.153		***
	(0.041)			(0.031)			(0.032)			(0.031)		
Bac plus vocational	0.182	***		0.188	***		0.076	**		0.196		***
	(0.044)			(0.033)			(0.035)			(0.034)		
Bachelors	0.248	***		0.250	***		0.053			0.290		***
	(0.062)			(0.041)			(0.048)			(0.045)		
Masters and above	0.443	***		0.325	***		0.224	***		0.297		***
	(0.051)			(0.038)			(0.044)			(0.042)		

Table 4.15 continued

	Labour force participation			*Use of formal care*		
	Age0-2		*Age 3-6*	*Age 0-2*		*Age3-6*	
Cities	-0.080		-0.113 ***	-0.019		-0.186	***
	(0.058)		(0.042)	(0.048)		(0.044)	
Densely populated	-0.063		-0.049	-0.025		-0.254	***
	(0.059)		(0.044)	(0.049)		(0.046)	
Rural	-0.027		-0.033	-0.076		-0.357	***
	(0.063)		(0.047)	(0.052)		(0.048)	
Constant	-1.484	***	-0.598	-0.728	*	-0.750	*
	(0.479)		(0.410)	(0.377)		(0.411)	
R^2	0.136		0.192	0.217		0.241	
N	2,314		3,652	2,314		3,652	

Note: Standard errors in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Regressions include controls for father's age and its square, dummies for father's level of education, trend and its square, regional dummies (NUTS3) and regional unemployment rate.

Table 4.16 reports the results of propensity score matching for a means tested voucher. The only significant results are those for the use of formal childcare for the older age group children. Furthermore, the results are positive for USE as expected. The results range from 7.9 percentage points with the nearest neighbour matching to 7.2-9.6 percentage points with the Epanechnikov kernel. In all cases the matching is above 98% and the support is thick with approximately 155 control observations accounting for half of the matches.

Table 4.16: Propensity score matching estimates (areas with a means-tested voucher)

	Labour force participation		*Use of formal care*		
	Age 0-2	*Age 3-6*	*Age 0-2*	*Age 3-6*	
Nearest Neighbour, caliper 0.1	0.009	-0.014	-0.003	0.078	**
	(0.045)	(0.031)	(0.045)	(0.035)	
	[100%]	[99.93%]	[100]	[99.93%]	
	{89}	{155}	{89}	{155}	
Nearest Neighbour, caliper 0.01	0.009	-0.012	0.003	0.080	**
	(0.046)	(0.031)	(0.044)	(0.035)	
	[99.71%]	[99.18%]	[99.71%]	[99.18%]	
	{90}	{155}	{90}	{155}	
Nearest Neighbour, caliper 0.005	0.009	-0.015	0.003	0.079	**
	(0.0463)	(0.031)	(0.044)	(0.035)	
	[97.38%]	[98.16%]	[97.38%]	[98.16%]	
	{90}	{156}	{90}	{156}	
Epanechnikov kernel, bandwidth 0.1	0.018	0.011	0.045	0.096	***
	(0.030)	(0.020)	(0.032)	(0.020)	
Epanechnikov kernel, bandwidth 0.01	0.005	0.011	0.047	0.076	***
	(0.032)	(0.020)	(0.033)	(0.022)	
Epanechnikov kernel, bandwidth 0.005	0.008	0.008	0.044	0.072	***
	(0.033)	(0.020)	(0.033)	(0.022)	
Observations	1,769	2,819	1,769	2,819	
of which treated	343	489	343	489	

Note: Standard errors reported in parentheses.
*** denotes significance at 1% level, ** at 5% level and * at 10% level of significance.
Standard errors obtained by bootstrapping (500 replications for nearest neighbour kernel; 100 replications for Epanechnikov kernel).
Percentage of treated observations matched to a control observation in square brackets.
Number of control observations accounting for 50% of match in curly brackets.

4.7 Estimated elasticities

I have estimated the elasticities of the private childcare subsidy with respect to the use of formal childcare and the labour force participation of mothers in areas of excess demand and in the whole country. The results are reported in Table 4.17.

Table 4.17: Elasticities for labour force participation and use of formal care

	LFP		*USE*	
	0-2	*3-6*	*0-2*	*3-6*
Whole country	-0.003	-0.008	0.010	0.022
Areas of excess demand	-0.005	0.014	0.034	0.052

The estimated elasticities reported in Table 4.17 indicate a very small impact of the amount of the private care voucher on labour force participation (LFP) and the use of childcare (USE) both in the whole country and in areas of excess demand for childcare. As expected though, the impact is larger in the areas of excess demand as expected. The results in section 4.6.1 indicated that the private childcare voucher increased the use of childcare by 13 percentage points for the children aged between three and six. However, these elasticity estimates indicate that a 1% increase in the average amount of the private childcare voucher increases the use of formal childcare by only half a percentage point. This elasticity estimate is significantly smaller than the majority of estimates found in the previous literature using reduced form models. However, studies using more thorough structural models find elasticity estimates of similar magnitude (see, for example, Anderson and Levine, 1999).

This small impact of the amount of the voucher on USE may indicate that the most important effect of the private childcare voucher was to lower the barriers to entry into the childcare market for the potential suppliers of private childcare. Hence once the private provision of childcare was available, the customers flooded in regardless of the price they had to pay.

These elasticity estimates are quite imprecise because the estimation uses the average level of the voucher across different municipalities and different voucher levels. Better data that enables us to identify the municipality would result in more accurate results.

4.8 Conclusion

This study has examined the impact of a childcare voucher on the labour force participation of mothers of pre-school age children and their use of formal childcare using an experimental set-up. Between 1995 and 1997 the Finnish government and the municipalities provided a voucher to be used for privately provided childcare services affecting approximately a quarter of the population.

The estimates of the private childcare voucher experiment are produced using both difference-in-differences as well as propensity score matching estimation. In a number of cases the difference-in-differences and propensity score matching estimates are very different. This suggests that the OLS assumption of linear functional form inherent in the difference-in-differences analysis fails. Additionally the use of cross-sectional data in this analysis cannot ensure that the

crucial assumption of difference-in-differences regarding the non-variability of time effects across the treated and the control groups holds. Hence further research should also examine whether difference-in-differences estimates improve with the use of panel data. Propensity score matching performs well with common support throughout the distribution hence providing strong identification.

None of the estimates are found to be significant for the mothers of 0-2 year old children, which is expected due to considerable financial support for parents under the age of three.

The results for the mothers of 3-6 year olds indicate that even with widely available high-quality, low-cost public childcare, a voucher for private childcare has a significant positive impact for the use of formal childcare, especially in areas that suffer from excess demand for childcare services. The use of formal childcare increased by between 3 and 6 percentage points in the whole country while in areas of excess demand the increase was approximately 14 percentage points. Labour force participation of mothers of older pre-school age children increased by over 5 percentage points in areas of excess demand.

The elasticity estimates of the private childcare subsidy indicate that an increase in the average amount of the private childcare voucher had a very small impact on the use of formal childcare. The small impact of the amount of the voucher on the use of childcare may indicate that the most important effect of the

private childcare voucher was to lower the barriers to entry into the childcare market for the potential suppliers of private childcare. Therefore it can be argued that the most important effect of the voucher was to boost private enterprise in the childcare market and hence increase the overall supply. Once the private provision of childcare was available, the customers started using the private childcare provision regardless of the price they had to pay for it.

Policy makers struggling with excess demand for childcare can use the estimates of private childcare voucher experiment in Finland to guide their choices regarding their childcare policies. Finland has a large, low-cost public childcare sector unlike many other Western economies. Hence it is reasonable to expect that a similar arrangement in a country with less childcare provision will have an even larger impact on the variables of interest.

CHAPTER FIVE: CONCLUSION

This thesis has attempted to shed more light on the problems currently faced in the UK childcare market including the low availability of formal childcare and its high price. My research points to a possible market failure in the childcare sector and attempts to give policy guidance on how best to improve the current situation.

Chapter 1 examines the previous literature on childcare and concludes that the existing research has not reached a consensus regarding the impact of the price of childcare on the use of childcare and on labour force participation. Also, the quality of childcare is found to be difficult, if not impossible, to measure. Furthermore, the majority of research conducted in this field is for the US with very few papers examining the markets for childcare in the European context.

The previous research is inconclusive on the efficiency of the childcare markets as well as the current policies regarding childcare financing and subsidisation. However, it is generally agreed that childcare provides benefits to society that far outweigh the costs to the individual consumers.

Chapter 2 concentrates on examining the impact of the availability of formal childcare within a Local Authority on the efficiency of the childcare markets. The efficiency of the childcare market is estimated by calculating the size of the queue for formal childcare. For the first time in this type of analysis, we account for partial observability: a woman uses childcare if she demands it and if her offer is accepted. This chapter provides first analytic evidence that there exists a sizeable excess demand for formal childcare in the UK, which confirms the previous descriptive evidence. The size of the queue for childcare is substantial: while a bit

more than 70% of mothers would like to use childcare, only 57% are provided with a place for their child. Furthermore, the queue is underestimated since we have imposed the exogeneity of the mother's labour force decision.

Furthermore, it appears that a majority of mothers queuing for childcare are using informal care as a substitute, thus a policy increasing the supply of formal care may not have a large impact on the labour force participation of women, but mostly shift children from informal care to formal care. Formal and informal care are close substitutes.

Chapter 3 concentrates on estimating the price elasticities of childcare in the UK with respect to its use and labour force participation. The knowledge of the childcare price elasticities is crucial in the formulation of effective childcare policies. The estimation results showed that, as expected, childcare price has a significant, negative effect on the probability of working and use of formal modes of childcare. The estimation relies on simultaneously modelling the use of childcare and the labour force participation of the mother. This method reflects the interrelated nature of the childcare choice and the labour force participation decision. Simultaneously accounting for non-random selection into use of formal childcare and employment, the estimated childcare price elasticity with respect to employment is -0.17 and with respect to the use of formal childcare is –0.09. Hence the demand for childcare is relatively inelastic.

Furthermore, this knowledge allows the simulation of different childcare policies. Baseline simulations, 50.7% for labour force participation and 28.1% for the use of childcare, come very close to replicating the observed participation and

use of formal childcare rates (50.5% and 27.4%, respectively). The simulation results show that if there were a universal zero-cost childcare available to the mothers in this sample the model predicts that 76.1% would be employed while only 44.8% would be using formal childcare. Almost a third of the mothers are hence predicted to use informal care when they work even if childcare were provided free of charge.

The results indicate sensitivity of female labour supply to the price of childcare. The policy-relevance of this topic is closely related to current government policy, for example, the Working Tax Credit (WTC). This policy relies heavily on a very elastic demand for childcare. The childcare component of the WTC distributes low-income working individuals money to be used for the payment of childcare. However, the decision to become employed depends on the characteristics of the individual as well as their wage and the price of the available childcare. Unfortunately this data does not cover the time period when the WTC has taken effect, however, the elasticity figures in this paper may give some indication of the likely impact of such policies.

Chapter 4 moves away from analysing the UK childcare markets and instead examines the childcare policies adopted in Finland. The Finnish childcare policy has traditionally relied on heavy public provision of formal childcare services. However, the escalating costs of universal public childcare provision led the policy makers' to introduce facets of competitive markets in the publicly provided model of childcare provision. This chapter examines the ways this competitive component, a private childcare voucher, affected the use of childcare and the labour force participation of mothers of young children. This study has examined the

impact of a private childcare voucher on the labour force participation of mothers of pre-school age children and their use of formal childcare using an experimental set-up.

The results for the mothers of 3-6 year olds indicate that even with widely available high-quality, low-cost public childcare, a voucher for private childcare has a significant positive impact for the use of formal childcare, especially in areas that suffer from excess demand for childcare services. The use of formal childcare increased by between 3 and 6 percentage points in the whole country while in areas of excess demand the increase was approximately 14 percentage points. Labour force participation of mothers of older pre-school age children increased by over 5 percentage points in areas of excess demand.

The elasticity estimates of the private childcare subsidy indicate that an increase in the average amount of the private childcare voucher had a small but significant impact on the use of formal childcare. This impact is expected since the price of childcare overall is relatively low. The small impact of the amount of the voucher on the use of childcare may indicate that the most important effect of the private childcare voucher was to lower the barriers to entry into the childcare market for the potential suppliers of private childcare. Therefore it can be argued that the most important effect of the voucher was to boost private enterprise in the childcare market and hence increase the overall supply. Once the private provision of childcare was available, the customers started using the private childcare provision regardless of the price they had to pay for it.

Policy makers struggling with excess demand for childcare can use the estimates of private childcare voucher experiment in Finland to guide their choices regarding their childcare policies. Finland has a large, low-cost public childcare sector unlike many other Western economies. Hence it is reasonable to expect that a similar arrangement in the UK will have an even larger impact on the variables of interest.

The current childcare provision in the UK is very fragmented with a large variation in the availability of childcare provision between one local authority and another. The diversity in the childcare services in the UK may partly be a consequence of the divides in government responsibility for childcare services[92]. It might be possible to achieve efficiency gains by concentrating all the pre-school services to one responsible government office. One office that is responsible for all the childcare provision can better formulate policies that attempt to increase the provision of childcare and its quality. The current, fragmented policy formulation may lead to more inequality in the long run by concentrating on small segments of the society. Small steps have been taken towards bringing the different children's services together (Every child matters, 2003) as well as raising the image and status of childcare work and recruiting more personnel into the childcare field.

Recent policy discussion in the UK involves increased reliance on employer-supported childcare, for example, the use of childcare vouchers provided by employers that are free of tax and national insurance (Inland Revenue, 2003). However, this policy may not have a large effect on the UK childcare markets if

[92] For example, the Department of Health has supported day nurseries that had the primary role of providing care for socially, emotionally, or materially deprived children aged 0-5. On the other hand, the Department for Education and Skills has concentrated on providing nursery schools and nursery classes or reception classes in primary schools.

potential childcare providers find it difficult to enter the market place. The high entry costs, which are partly due to heavy regulation regarding the childcare premises, are often quoted as the reason for the lack of suppliers in the childcare market.

Furthermore, the survey of childcare providers in the UK discussed in Chapter 1 indicates that many childcare providers are constrained in the provision of their services due to staffing constraints and constraints on the available facilities. It may be desirable that the government participates in the building of childcare facilities either directly or by giving the providers tax breaks or subsidies. The survey of childcare workers and students indicates that the majority of current and future childcare employees are eager to work in the field. However, the low wages in the profession deter them from remaining in the profession for long.

In the summer of 2002 Gordon Brown announced the doubling of government childcare expenditure by 2005-6. However, by international standards this higher level of spending would still fall short of the OECD average of 0.7% of GDP spent on childcare. Furthermore, the effectiveness of the childcare policies depends on whether the subsidies or tax breaks are provided for the supply or the demand side of the market. Evidence in Chapter 3 indicates that demand side subsidies in the UK would have a very small effect on both the use of childcare and the labour force participation of mothers of pre-school age children.

The main policy recommendation based on this thesis includes the introduction of a private childcare voucher, which is independent of parental income. The Finnish experience presented in Chapter 4 indicates that this arrangement affected

both the supply and the demand side of the market. As a result of the voucher private entrepreneurs received the necessary incentive to enter a market place with many competitors (large public sector provision) and high barriers to entry (tight regulation) by differentiating their product from that of their competitors (more specialised childcare). Chapter 4 indicates that this differentiated product was appealing enough for the consumers and some previously non-employed mothers entered the labour force as a consequence.

Pre-school childcare provision is a topic that deserves further research for several reasons. First, high quality childcare may provide the earliest possible starting date for reducing inequalities in children's later outcomes that may be due to, for example, low parental income. Very few studies have looked into the impact of the mode of childcare on the children's later outcomes on one hand because of the lack of appropriate data and on the other hand because it is difficult to disentangle the impact of childcare *per se* on a child outcome at a later date.

Second, access to affordable childcare may reduce the wage gap between mothers and childless women by allowing the former to continue employment after childbearing. It is desirable that women, who are often highly educated, have the option to continue employment after childbearing to reduce the impact of the time outside of the labour market on, for example, wage growth or job tenure. For the same reason, it may also reduce the gender wage gap. In general countries with a large affordable childcare sector also exhibit the lowest gender wage gaps.

REFERENCES:

Abadie, A. and Imbens, G. (2001) "Simple and bias corrected matching estimators for average treatment effects", mimeo, Harvard University.

Abowd, J.M. and Farber, H.S. (1982) "Job Queues and the Union Status of Workers", *Industrial and Labor Relations Review*, 35(3): 354-367.

Akerlof, G.A. (1970) "The Market for "Lemons": Quality, Uncertainty and the Market Mechanism", *The Quarterly Journal of Economics*, 84(3): 488-500.

Ailasmaa, R. (2000) "Sosiaali- ja terveydenhuollon henkilöstö kuntasektorilla 1999", STAKES Statistical Report 10/2000.

Anderson, P.M. and Levine, P.B. (1999) "Child Care and Mothers' Employment Decisions", NBER Working Paper No. 7058.

Averett, S.L., Peters, H.E. and Waldman, D.M. (1997). "Tax Credits, Labor Supply, and Child Care", *The Review of Economics and Statistics*, 79(1): 125-135.

Becker, G. (1981) "A Treatise on the Family", Harvard University Press: Cambridge, MA.

— (1996) "Accounting for Tastes", Harvard University Press: Cambridge, MA.

Berger, M.C. and Black, D.A. (1992) "Child Care Subsidies, Quality of Care, and the Labor Supply of Low-Income, Single Mothers", *The Review of Economics and Statistics*, 74(4): 635-642.

Bergstrom, T. and Blomquist, S. (1996) "The Political Economy of Subsidized Day Care", *European Journal of Political Economy*, 12: 443-457.

Bertrand, M., Duflo, E., and Mullainathan, S. (2004) "How Much Should We Trust Differences-in-Differences Estimates", *The Quarterly Journal of Economics*, 119(1): 249-275.

Besharov, D.J. and Samari, N. (2000) "Child-Care Vouchers and Cash Payments" in Steuerle, C.E, Van Doorn Ooms, Peterson, G. and Reischauer, R.D. (eds.) *Vouchers and the Provision of Public Services*, Brookings Institution Press.

Blake, M., Finch, S., Gloyer, M., Hinds, K. and Bajekal, M. (2000) *Third Survey of Parents of Three and Four Year Old Children and Their Use of Early Year Services (Summer 1998 to Spring 1999)*, Research Report No. RR189, London: Department for Education and Employment.

Blake, M., Finch, S., McKernan, A. and Hinds, K. (2001) *4th Survey of Parents of Three and Four Year Old Children and Their Use of Early Year Services*

(Spring 1999 to Spring 2000), Research Report No. RR247, London: Department for Education and Employment.

Blau, D.M. (1991) *The Economics of Child Care*. Russell Sage Foundation, New York.

— (1992) "The Child Care Labor Market", *Journal of Human Resources*, 27(1): 9-39.

— (1993) "The Supply of Child Care Labor", *Journal of Labor Economics*, 11(2): 324-347.

— (1998) "The Production of Quality in Child Care Centers", *The Journal of Human Resources*, 32(2): 354-387.

— (2000) "Child Care Subsidy Programs", NBER Working Paper No. 7806.

— (2000) "The Production of Quality in Child-Care Centers: Another Look", *Applied Developmental Science*, 4(3): 136-148.

— (2001) *The Child Care Problem: An Economic Analysis*. Russell Sage Foundation, New York.

— (2003) "Child Care Subsidies as Social Policy", *Dice Report: Journal for Institutional Comparisons*, 1(4): 3-7.

Blau, D.M. and Mocan, H.N. (2002) "The Supply of Quality in Child Care Centers", *The Review of Economics and Statistics*, 84(3): 483-496.

Blau, D.M. and Robins, P.K. (1988) "Child-Care Costs and Family Labor Supply", *The Review of Economics and Statistics*, 70(3): 374-381.

— (1989) "Fertility, Employment, and Child-Care Costs", *Demography*, 26(2): 287-299.

— (1991) "Child Care Demand and Labour Supply of Young Mothers over Time", *Demography*, 28: 333-351.

— (1991) "Turnover in Child Care Arrangements", *The Review of Economics and Statistics*, 73(1): 152-157.

— (1998) "A Dynamic Analysis of Turnover in Employment and Child Care", *Demography*, 35(1): 83-96.

Blau, F. and Ferber, M.A. (1992) *The Economics of Women, Men, and Work*. Englewood Cliffs: Prentice-Hall.

Bloom, D.E. and Steen, T.P. (1990) "The Labor Force Implications of Expanding The Child Care Industry", *Population Research and Policy Review*, 9: 25-44.

Blundell, R. and Costa Dias, M. (2002) "Alternative Approaches to Evaluation in Empirical Microeconomics", *Portuguese Economic Journal*, 1(2): 91-115.

Blundell, R. and MaCurdy, T. (1999) "Labor Supply: A Review of Alternative Approaches", in O. Ashenfelter and D. Card (eds.) *Handbook of Labor Economics*, Elsevier.

Bradford, D.F. and Shaviro, D.N. (2000) "The Economics of Vouchers", in Steuerle, C.E, Van Doorn Ooms, Peterson, G. and Reischauer, R.D. (eds.) *Vouchers and the Provision of Public Services*, Brookings Institution Press.

Brandon, P.D. (1995) "An Economic Analysis of Kin-Provided Child Care", Institute for Research on Poverty, Discussion Paper No. 1076-95.

Browning, M. (1992) "Children and Household Economic Behavior", *Journal of Economic Literature*, 30: 1434-1475.

Callender, C. (2000) *The Barriers to Childcare Provision*. Research Report No. RR231, London; Department for Education and Employment.

Callender, C., Millward, N., Lissenburgh, S. and Forth, J. (1997) *Maternity Rights and Benefits in Britain*, DSS Research Report No. 67, London: Stationery Office.

Cameron, C., Owen, C. and Moss, P. (2001) "Entry, Retention and Loss: A Study of Childcare Students and Workers", DfES Research Report No. 275, London.

Cameron, S. and Taber, C. (2000) "Borrowing Constraints and the Returns to Schooling", NBER Working Paper No. 7761.

Carneiro, P. and Heckman, J. (2003) "Human Capital Policy", NBER Working Paper No. 9495.

Cattan, P. (1991) "Child-Care Problems: an Obstacle to Work", *Monthly Labor Review*, 3-9.

Chaplin, D.D., Robins, P.K., Hofferth, S.L., Wissoker, D.A. and Fronstin, P. (1999) "The Price Sensitivity of Child Care Demand: A Sensitivity Analysis" Unpublished manuscript.

Chevalier A. and Viitanen, T.K. (2002) 'The Causality Between Female Labour Force Participation and the Availability of Childcare', *Applied Economic Letters*, 9(14): 915-918.

Chiappori, P.-A., Blundell, R. and Meghir, C. (2002) "Collective Labour Supply with Children", The Institute for Fiscal Studies, WP02/08.

Choné, P., le Blanc, D. and Robert-Bobée, I. (2003) "Female Labor Supply and Child Care in France", mimeo, CREST-INSEE.

Cleveland, G., Gunderson, M. and Hyatt, D. (1996) "Child Care Costs and the Employment Decision of Women: Canadian Evidence", *Canadian Journal of Economics*, 29(3): 132-151.

Connelly, R (1992) "The Effect of Child Care Costs on Married Women's Labor Force Participation", *The Review of Economics and Statistics*, 74(1): 83-90.

--- and Kimmel, J. (2000) "Marital Status and Full-time/Part-time Work Status in Child Care Choices", Upjohn Institute Working Paper No. 99-58.

Currie, J. and Hotz, V.J. (2001) "Accidents Will Happen? Unintentional Injury, Maternal Employment, and Child Care Policy", NBER Working Paper No. 8090.

Daycare Trust (1997) "Working Wonders: quality of staff, quality services", Briefing Paper No. 2.

--- (2001a) "Quality Matters: Ensuring Childcare Benefits Children", Publication No. 2.

--- (2001b) "The Price Parents Pay: Sharing the Costs of Childcare", Publication No. 3.

--- (2004) "Childcare Costs Rise to Record Levels", Press Release, 03.02.2004.

Dehejia, R. and Wahba, S. (2002) "Propensity Score-Matching Methods for Nonexperimental Causal Studies", *Review of Economics and Statistics*, 84: 151-161.

Del Boca, D., Locatelli, M. and Vuri, D. (2003) "Child Care Choices by Italian Households", Centre for Household, Income, Labour and Demographic Economics Discussion Paper No. 30.

Department for Education and Employment (1998) 'Meeting the Childcare Challenge', Report on the National Childcare Strategy

Department of Health (1994). *Children's Day Care Facilities at 31 March 1994*: England, London: HMSO.

--- (1995). *Children's Day Care Facilities at 31 March 1995*: England, London: HMSO.

--- (1996). *Children's Day Care Facilities at 31 March 1996*: England, London: HMSO.

--- (1997). *Children's Day Care Facilities at 31 March 1997*: England, London: HMSO.

--- (1998). *Children's Day Care Facilities at 31 March 1998*: England, London: HMSO.

Donovan, S. and Watts, H. (1990) "What Can Child Care Do for Human Capital?", *Population Research and Policy Review*, 9: 5-23.

Duncan, A. and Giles, C. (1996) "Should We Subsidise Pre-School Childcare, and If So, How?", *Fiscal Studies*, 17(3): 39-61.

Duncan, A., Paull, G. and Taylor, J. (2001a) "Price and Quality in the UK Childcare Market", the Institute for Fiscal Studies Working Paper No. WP01/14.

--- (2001b) "Mothers' Employment and the Use of Childcare in the United Kingdom", the Institute for Fiscal Studies Working Paper No. WP01/23.

Duncan, A. and Webb, S. (1995) "The Impact of Subsidising Childcare", IFS Research Discussion Series No.13, printed by Equal Opportunities Commission, Manchester.

Ekeland, I., Heckman, J.J., and Nesheim, L. (2002) "Identifying Hedonic Models", Cemmap Working Paper No. CWP06/02.

Ermisch, J.F. and Wright, R.E. (1991) "Welfare Benefits and Lone Parents' Employment in Great Britain", *Journal of Human Resources*, 26(3): 424-456.

Every Child Matters (2003) UK Government Green Paper, Published 15.9.2003.

Finlayson L.R., Ford, R. and Marsh, A. (1996) "Paying More for Child Care", *Labour Market Trends*, July, 295-303.

Fishe, R.P.H., Trost, R.P. and Lurie, P.H. (1981) "Labor Force Earnings and College Choice of Young Women: An Examination of Selectivity Bias and Comparative Advantage", *Economics of Education Review*, 1(2): 169-191.

Fong, M. and Lokshin, M. (2000) "Child Care and Labor Force Participation in Romania", mimeo, World Bank.

Forth, J., Lissenburgh, S., Callender, C. and Millward, N. (1996) *Family Friendly Working Arrangements in Britain*, Department for Education and Skills, Research Report No. 16.

Fuchs, V.R. (1988) *Women's Quest for Economic Equality*, Harvard University Press, Cambridge, MA.

Gornick, J.C., Meyers, M.K. and Ross, K.E. (1998) "Public Policies and the Employment of Mothers: A Cross-National Study", *Social Science Quarterly*, 79(1), 35-54.

Green Paper (1998) *Meeting the Childcare Challenge: A Framework and Consultation Document*, presented to Parliament by the Secretary of State for Education and Employment and the Secretary of State for Social Security and Minister for Women, Cm. 3959, London: Stationery Office.

Gregg, P. and Harkness, S. (2003) "Welfare Reform and Lone Parents Employment in the UK", CMPO Working Paper Series No. 03/072.

Gustafsson, S. and Stafford, F. (1992) "Child Care Subsidies and Labor Supply in Sweden", *Journal of Human Resources*, 27(1): 204-230.

Hanushek, E.A., Rivkin, S.G., and Taylor, L.L. (1996) "Aggregation and the Estimated Effects of School Resources", *The Review of Economics and Statistics*, 78(4): 611-627.

Harkness, S. and Waldfogel, J. (1999) "The Family Gap in Pay: Evidence from Seven Industrialised Countries", CASE Working Paper No. 29.

Heckman, J.J. (1979) "Sample Selection Bias as a Specification Error", *Econometrica*, 47: 153-161.

Heckman, J.J., Ichimura, H., and Todd, P. (1997) "Matching as an Econometric Evaluation Estimator: Evidence from Evaluating a Job Training Program", *Review of Economic Studies*, 64: 605-654.

--- (1998) "Matching as an Econometric Evaluation Estimator", *Review of Economic Studies*, 65, 261-294.

Heckman, J.J., Matzkin, R., and Nesheim, L. (2003) "Simulation and Estimation of Hedonic Models", Cemmap Working Paper No. CWP10/03.

Heikkilä, M. and Takala, P. (1999) "Kuinka lapset hoidetaan Suomessa: Alustavia tuloksia valtakunnallisesta lastenhoitotutkimuksesta", STAKES Aiheita 23/1999.

Heikkila, M. and Törmä, S. (1996) "Kokemuksia markkinaehtoisesta päivähoidosta – väliraportti lasten päivähoidon valtakunnallisesta palvelurahakokeilusta", Sosiaali- ja Terveysministeriö, Monisteita 1996:5.

Hemmings, P., Turner, D. and Parviainen, S. (2003). "Enhancing the Effectiveness of Public Spending in Finland", OECD Economics Department Working Paper No. 358.

Heywood, J. and M. Mohanty (1995) "Estimation of the US Federal Job Queue in the Presence of an Endogenous Union Queue", *Economica*, 62, 479-93

Hofferth, S.L. and Wissoker, D.A. (1992) "Price, Quality, and Income in Child Care Choice", *Journal of Human Resources*, 27(1): 70-111.

Holloway, S. and Tamplin, S. (2001) "Valuing Informal Childcare in the UK", Office for National Statistics, Household Satellite Account Branch Working Paper.

Holtermann, S. (1992) *Investing in Children: Costing and Funding and Educational and Daycare Service for Children*. London: National Children's Bureau.

Ilmakunnas, S. (1997) "Female Labour Supply and Work Incentives" Helsinki: Palkansaajien Tutkimuslaitos. Tutkimuksia n:o 68.

Independent, "British Childcare is Worst in Europe", 2 September 2001.

Inland Revenue (2001) "New Tax Credits – Supporting families, Making Work Pay and Tackling Poverty", July.

Inland Revenue (2003) "Employer-Supported Childcare", Press Release, Published: 10.12.2003.

Jaumotte, F. (2003) "Female Labour Force Participation: Past Trends and Main Determinants in OECD Countries", OECD Economics Department Working Paper No. 376.

Jenkins, S.P. and Symons, E.J. (2001) "Child Care Costs and Lone Mothers' Employment Rates: UK Evidence", *The Manchester School*, 69(2): 121-147.

Joesch, J.M. and Hiedemann, B.G. (2002) "The Demand for Nonrelative Child Care Among Families With Infants and Toddlers: A Double-Hurdle Approach", *Journal of Population Economics*, 15: 495-526.

Johtoryhmän muistio (1997) "Lasten päivähoidon palvelurahakokeilu" Sosiaali- ja terveysministeriön Työryhmämuistioita 1997:26.

Kajanoja, J. (1999) "Lasten päivähoito investointina", VATT Research Reports No. 50, Government Institute for Economic Research, Helsinki.

Kasparova, D., Marsh, A., Vegeris, S. and Perry, J. (2003) "Families and Children 2001: Work and Childcare", Department for Work and Pensions, Research Report No. 191.

Killingsworth,M.R. and Heckman,J.J. (1986) "Female Labor Supply: a Survey" pp.103-204 in Orley C. Ashenfelter and Richard Layard, eds., *Handbook of Labor Economics*, Vol. 1, New York: North-Holland

Kimmel, J. (1995) "The Effectiveness of Child Care Subsidies in Encouraging the Welfare-to-Work Transition of Low-income Single Mothers", *American Economic Review, Papers and Proceedings*, 85(2): 271-275.

--- (1998) "Child Care Costs as a Barrier to Employment for Single and Married Mothers", *The Review of Economics and Statistics*, 80(2): 287-299.

--- and Connelly, R. (2003) "A Longitudinal Study of Child Care Workers in the United States", mimeo.

Kimmel, J. and Powell, L.M. (2001) "Nonstandard Work and Child Care Choices of Married Mothers", Upjohn Institute Staff Working Paper No. 01-74.

Knight, A., Mooney, A., Moss, P., and Owen, C. (2001) "Who Cares? Childminding in the 1990's", Family Policy Studies Centre for The Policy Press in association with Joseph Rowntree Foundation.

Kreyenfeld, M. and Hank, K. (2000) "Does The Availability of Child Care Influence The Employment of Mothers? Findings from Western Germany", *Population Research and Policy Review*, 19: 317-337.

Kreyenfeld, M., Spiess, C.K., and Wagner, G.G. (2000) "A Forgotten Issue: Distributional Effects of Day Care Subsidies in Germany", IZA Discussion Paper No. 198.

Kurjenoja, J. (2001) "Perhetuen kansainvälinen vertailu", *Verotietoa*, No. 28.

Land, Hilary (2002) "Meeting the Child Poverty Challenge: Why Universal Childcare Is Key to Ending Child Poverty", Childcare Trust Facing the Future Policy Paper No.3

Lasten päivähoitopalvelut – kilpailua ja valinnanvapautta (1995) VATT Discussion Paper 84, Government Institute for Economic Research (VATT), Helsinki.

Lasten päivähoitoselvitys – syyskuu 1997 (1998) Sosiaali- ja terveysministeriö Monisteita 1998:20.

La Valle, I., Finch, S., Nove, A. and Lewin, C. (2000) *Parents' Demand for Childcare*, Research Report No. RR176, London: Department for Education and Employment.

Lechner, M. and Pfeiffer, F. (2001) "Identification and Estimation of Causal Effects of Multiple Treatments under the Conditional Independence Assumption" in Econometric Evaluation of Labour Market Policies, Heidelberg: Physica/Springer, pp. 43-58

Lehrer, E. (1983) "Determinants of Child Care Mode Choice", *Social Science Research*, 12: 69-80.

--- (1989) "Preschoolers with Working Mothers. An Analysis of the Determinants of Child Care Arrangements", *Journal of Population Economics*, 1: 251-268.

Leibowitz, A., Waite, L.J. and Witsberger, C. (1988) "Child Care for Preschoolers: Differences by Child's Age", *Demography*, 25: 205-220.

Leibowitz, A., Klerman, J.A. and Waite, L.J. (1992) "Employment of New Mothers and Child Care Choice", *Journal of Human Resources*, 27: 112-133.

Lissenburgh S. (2000) "Gender discrimination in the labour market", *Policy Studies Institute*, RP 3, London

Maddala, G.S. (1983) *Limited-Dependent and Qualitative Variables in Econometrics*. Econometric Society Monographs No. 3. Cambridge: Cambridge University Press.

Marsh, A. and McKay, S. (1993) "Families, Work and the Use of Child Care", *Employment Gazette*, August, 361-370.

Mason, K.O. and Kuhlthau, K. (1989) "Determinants of Child Care Ideals Among Mothers of Preschool-Aged Children", *Journal of Marriage and the Family*, 51: 593-603.

Mason, K.O. and Kuhlthau, K. (1992) "The Perceived Impact of Child Care Costs on Women's Labor Supply and Fertility", *Demography*, 29(4): 523-543.

Meltzer, H. (1994) *Day Care Services for Children*. HMSO: London.

Meyer, B.D. (1995) "Natural and Quasi-Experiments in Economics", *Journal of Business & Economic Statistics*, 13(2): 151-161.

Mincer, J. (1974) *Schooling, Experience, and Earnings*. New York: National Bureau of Economic Research.

Mocan, H.N. (2001) "Can Consumers Detect Lemons? Information Asymmetry in the Market for Child Care", NBER Working Paper No. 8291.

Mocan, H.N. and Tekin, E. (2000) "Nonprofit Sector and Part-Time Work: An Analysis of Employer-Employee Matched Data of Child Care Workers", NBER Working Paper No. 7977.

--- and Viola, D. (1997) "The Determinants of Child Care Workers' Wages and Compensation: Sectoral Difference, Human Capital, Race, Insiders and Outsiders", NBER Working Paper No. 6328.

Moss, P. (2001) "The UK at the Crossroads: Towards an Early Years European Partnership", Daycare Trust Policy Paper No. 2.

Moss, P., Mooney, A., Munton, T. and Stratham, J. (1998) *Local Assessment of Childcare Need and Provision*, London: HMSO, DfEE Research Report RR72.

Mroz, T.A. (1987) "The Sensitivity of an Empirical Model of Married Women's Hours of Work to Economic and Statistical Assumptions", *Econometrica*, 55: 765-800.

Mulligan, J.G. and Hoffman, S.D. (1998) "Daycare Quality and Regulation: A Queuing-Theoretic Approach", *Economics of Education Review*, 17(1): 1-13.

Munton, T., McCullum, B, and Rivers, K. (2001) "Childcare Quality Improvement and Assurance Practices", DfEE Research Brief No. 266.

Palokangas, J. (1995) "Lasten päivähoito-oikeuden laajentamisen kustannusvaikutus julkiselle taloudelle", VATT Discussion Paper 97, Government Institute for Economic Research (VATT).

Parker, M.D. (1989) "Vouchers for Day Care of Children: Evaluating a Model Program", *Child Welfare*, Vol. 68, No. 6, pp. 633-642.

Paull, G. and Brewer, M. (2003) "How Can Suitable, Affordable Childcare Be Provided for All Parents Who Need It to Enable Them to Work", The Institute for Fiscal Studies Briefing Note No. 34.

Paull, G. and Taylor, J. (with Duncan, A.) (2002) *Mother's employment and childcare use in Britain*, The Institute for Fiscal Studies, Glasgow: Bell and Bain Ltd.

Peterson, P.E., Howell, W.G., Wolf, P.J., and Campbell, D.E. (2001) "School Vouchers: Results from Randomized Experiments", presented at the NBER Conference on School Choice in February 2001.

Poirier, D.J. (1980). "Partial Observability in Bivariate Probit Models", *Journal of Econometrics*, 12: 209-217.

Powell, L.M. (1997) "The Impact of Child Care Costs on the Labour Supply of Married Mothers: Evidence from Canada", *Canadian Journal of Economics*, 3(3): 577-594.

--- (1998) "Part-time Versus Full-time Work and Child Care Costs: Evidence for Married Mothers", *Applied Economics*, 30: 503-511.

--- (2002) "Joint Labor Supply and Childcare Choice Decisions of Married Mothers", *Journal of Human Resources*, 37(1): 106-128.

Rake, K. (2000) "Into the Mainstream? Why Gender Audit is an Essential Tool for Policy Makers", *New Economy*, 7(2): 107-110.

Randall, V. and Fisher, K. (1999) "Towards Explaining Child Day Care Policy Variations Amongst the Local Authorities", ISER, Essex.

Ribar, D.C. (1992) "Child Care and the Labor Supply of Married Women", *Journal of Human Resources*, 27(1): 134-165.

--- (1995) "A Structural Model of Child Care and the Labor Supply of Married Women", *Journal of Labor Economics*, 13(3): 558-597.

Rosen, S. (1974) "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition", *Journal of Political Economy*, 82(1): 35-55.

Rosenbaum, P.R. and Rubin, D.B. (1985) "Constructing a Comparison Group Using Multivariate Matched Sampling Methods That Incorporate the Propensity Score", *The American Statistician*, 39, 33-38.

Shimizutani, S. and Noguchi, H. (2004) "Provision of Child Care and Female Labor Supply: Evidence from Japanese Household Level Data", Economic and Social Research Institute, Government of Japan, Discussion Paper No. 89.

Sipilä, J. and Korpinen, J. (1998) "Cash versus Child Care Services in Finland", *Social Policy & Administration*, 32(3):263-277.

Sly, F. (1994) "Mothers in the Labour Market", *Employment Gazette*, November, 403-413.

Steuerle, C.E, Van Doorn Ooms, Peterson, G. and Reischauer, R.D. (2000) *Vouchers and the Provision of Public Services*, Brookings Institution Press.

Takala, P. (2000) *Lastenhoito ja sen julkinen tuki*, STAKES Tutkimuksia 110, Helsinki.

Tunali, I. (1986) "A General Structure for Models of Double-Selection and an Application to a Joint Migration/Earnings Process with Remigration", *Research in Labor Economics*, 8(B): 235-282.

Vaajakallio, L. (1999) "Lasten päivähoito 1995-1998", Statistics Finland Reviews 1999/1.

Vandell, D.L. and Wolfe, B. (2000) "Child Care Quality: Does It Matter and Does It Need to be Improved", Institute for Research on Poverty Special Report No. 78, University of Wisconsin-Madison.

Vartiainen, J. (1998) "The Labour Market in Finland: Institutions and Outcomes", Prime Minister's Office, Publication Series 1998/2.

Viitanen, T.K. (2004). "The Impact of Children on Female Earnings in Britain", DIW Discussion Paper No. 415.

Voicu, A. and Buddelmeyer, H. (2003) "Children and Women's Participation Dynamics: Transitory and Long-Term Effects", IZA Discussion Paper No. 729.

Waldfogel J. (1998) "The Family Gap for Young Women in the United States and Britain: Can Maternity Leave Make a Difference?" Journal of Labor Economics; 16, 505-45.

Waldfogel, J. (2002) "Child Care, Women's Employment, and Child Outcomes", *Journal of Population Economics*, 15: 527-548.

Walker, J.R. (1992) "New Evidence on the Supply of Child Care: A Statistical Portrait of Family Providers and An Analysis of Their Fees", *Journal of Human Resources*, 27(1): 40-69.

Wilson, R. and Green, A.E. (2001) "*Projections of Occupations and Qualifications: 2000/2001: Research in Support of the National Skills Taskforce*", Sheffield: Department for Education and Employment.

Witte, A.D. and Queralt, M. (2002) "Take-up Rates and Trade Offs After the Age of Entitlement: Some Thoughts and Empirical Evidence for Child Care Subsidies", NBER Working Paper No. 8886.

Woodland, S., Miller, M. and Tipping, S. (2002) "Repeat Study of Parents' Demand for Childcare", DfES Research Report No. 348.

Wrohlich, K. (2004) "Child Care Costs and Mothers' Labor Supply: An Empirical Analysis for Germany", DIW Discussion Paper No. 412.

APPENDIX ONE: UK CHILDCARE SYSTEM

The Children Act of 1989 was implemented on 14 October 1991 and it changed the legal framework for the provision and registration of day care facilities in the UK. All childcare services (childminders, playgroups, and day nurseries) are, as a result, required to be registered with the local authority (Social Services Department) under the Children Act 1989 (Part X), most of which are subject to an annual inspection. However, services with a grant for nursery education are also inspected every four years under the Nursery Education and Grant Maintained Schools Act of 1996. The Children Act governs premises and staffing levels[93].

Local maintained nursery schools, primary schools with nursery classes and independent schools are subject to inspection by Office for Standard in Education (OFSTED) under the Schools Inspection Act 1996. From 2001 onwards, there should be a single inspection for all of above by OFSTED. Unregistered services include, for example, nannies or au pairs[94]. OFSTED inspects maintained schools providing nursery education under the School Inspection Act of 1996.

Factors that influence mothers' decision to become employed: 1/3 financial necessity (59% for lone mothers versus 29% for partnered women), 18% financial independence, 25% said intrinsic interest in work, 42% of mothers with no qualifications said socialisation (La Valle et al., 2000). The reasons for mothers staying home include: lack of family friendly and flexible work arrangements, perception of low employability, financial considerations, for example, loss of

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[93] Children Act covers children aged eight and under in cases where more than two hours of childcare per day are regularly provided. The staff-child ratios are: 1:3 for 0-2 yrs, 1:4 for 2-3 yrs, 1:8 for 3-8 yrs.

[94] A survey by Finlayson et al. (1996) found that 2% of working mothers with dependent children use nannies.

benefits, 25% said lack of affordable and adequate childcare. The likelihood of paid employment rises steadily with the age of the youngest child from 45% for 1 year olds to 78% for 16-18 year old children's mothers (Paull and Taylor, 2002). There is no sudden increase in employment when the youngest child starts school. However, they do not take into account that the ones who may be really constrained in their employment due to childcare put their child to an early education class at primary school before the official school starting age. Paull and Taylor (2002) further find that the total costs of childcare rather than age related costs are most important affecting the propensity to work of the mother. 66% of surveyed mothers said they would work if there was quality affordable childcare. 90% of mothers expect government and employers to do more to help working families. 36% of respondents said they had difficulty paying for childcare. 18% of parents would like to work term and school time only so they could look after their children themselves (La Valle et al., 2000).

Callender (2000) finds that demand for formal childcare in the UK is influenced by local availability of childminder places and out-of-school club places. Finlayson et al. (1996) examine UK surveys with nationally representative estimates of patterns of childcare use and family spending on childcare.[95] They report a rise in the percentage of mothers using childcare in the 1990's. The increase in the use of formal care is due to the increased use of childcare by married mothers while lone parents' use has remained stable. They find that 55% of working mothers in 1994 used informal forms of childcare. Family spending on childcare has risen between 1991 and 1994 controlling for wage inflation; ¼ of

[95] These are large (over 3000 families with working mothers) postal surveys from 1991, 1992, and 1994 that were carried out as part of the Policy Studies Institute/Department of Social Security Programme into Low Income Families (PRILIF).

mothers who work pay for childcare and that cost has increased by 26%. Average hourly cost of childcare has increased from £1.10 in 1991 to £1.54 in 1994, which is a significant increase controlling for wage inflation. 49% of parents had paid for the childcare used in last week (40% for fees and wages only). Median childcare costs were £19 per week for those who paid. Possible reasons that mothers pay more for childcare per week and per hour worked include: 1) increase in the consumption of childcare, which raises the price of limited supply, 2) increase in the preferences for higher quality care, 3) increase in use of formal care, 4) increase in the number of hours worked by mothers, and 5) increase in the unit costs of childcare unrelated to demand side factors. The impact of mother's earnings on childcare choices is found to be greater than that of other family income in the UK hence policies affecting mother's income are likely to be more effective (Paull and Taylor, 2002).

In 1991, 37% of families used parental care, while 13% supplemented parental care with other forms of free care provided by other family and friends. ½ used some form of formal care, of which ¼ was free. 40% of families paid for childcare (Duncan and Giles, 1996) [96]. In the late 1990's, 86% used some form of childcare in the last year while 57% used some form in the last week. 47% of 0-2 yr olds received some form of care last week (La Valle et al., 2000) [97]. Usage the week prior to the survey was highest for lone parents with full-time employment at 77%, and for couples where both parents are employed at 70%. Use of childcare is highest among families with non-manual jobs and for those in higher income

[96] Duncan and Giles (1996) use childcare information in the 1991-92 GHS with a sample of 1288 households with at least one pre-school age child.
[97] La Valle et al. (2000) examine the parents' demand for childcare by using the results from a Baseline Survey of Parents' Demand for Childcare for children aged 14 and under in England and Wales.

groups. 3-4 yr olds were most likely to have received formal care. Childcare used was most likely to be informal and most often by grandparents. In 1994 67% of married mothers used any childcare, while 23% use professional childcare, with 11% using childminder services, 5 % nursery or crèche, and 6% nursery schools or playgroups (Finlayson et al., 1996).

Day Care Trust (1997) estimates that registered childcare services for pre-school and school age children cater for an estimated 1 in 9 children less than 8. Volume in some services is declining (LA day nurseries, playgroups, childminders) while others are growing rapidly (private and voluntary sector day nurseries, after school clubs, holiday schemes). Randall and Fisher (1999) find that the provision of local authority provided care is highest in London and lowest in non-metropolitan counties, however, including private provision, the counties offered the highest number of places while metropolitan boroughs offered the fewest number of places.

Munton et al. (2001) examine how quality assurance and quality improvement schemes are being used in childcare in day nurseries, out-of-school clubs and childminding networks. Most accreditation on childcare quality concerns the promotion of health and safety as well as equal opportunities. Only 12% of nurseries have taken part in any accreditation scheme. The childcare providers that were more likely to have gone for accreditation were more likely to be larger facilities (more than 30 places) and to have been open for less than five years.

Registered childminders are self-employed child carer workers who look after the children in their own home. They must be registered with the local authority

(LA) and inspected once a year. Childminders can care for up to six children aged under eight of whom no more than three must be aged under five, at any one time. They are limited to one or two babies at one time. On average, childminders look after three children with the average age of 2.4 years (Callender, 2000). The childminders set the charges themselves and there is no national rate, however, most charge between £60 and £120 per child per week for full-time care. The average price at the national level reported by the Day Care Trust is £88.87.

For many parents, childminders are seen as a more flexible and affordable option than a nursery, for example, by providing care all year around for the full adult working day. Childminding is a major source of employment in the field of childcare. According to a study by Thomas Coram Research Unit, childminders are the main providers of formal childcare accounting for nearly a quarter of children receiving non-parental formal care. However, the number of childminders has fallen in the recent years. Knight et al. (2001) quote possible reasons for the decreasing number of childminders as: lack of support for childminding at the local authority level, low pay and poor status of work, increased regulatory demands and increased provision of places by other modes of childcare. According to the National Childminding Association, 70% of childminders have no relevant qualifications for looking after children and 23% have no qualifications at all. The average gross weekly income for childminders in late 1990's was £103.

Preschool playgroups usually provide play and education sessions lasting about 2½ to three hours per day. They are also registered and inspected by LA. Some provide free early education and are inspected by OFSTED. Playgroups usually care for children aged 2 ½ to 5 yrs. At least half the staff must be trained to work

with children. Recommendation is that there is one member of staff for every eight children aged three to five and one adult for every four children aged two to three. Most are run on a self-help basis by groups of parents with 1-2 paid staff, while some are run by the local authority. Playgroups tend to develop in areas with little childcare provision. Around 90% of playgroup places involve some cost or charges. Preschool playgroup costs between £2 to £5 per session. 56% of playgroups and pre-school schemes are run by voluntary organizations. Playgroups cater 2-4 yr olds and while school-age children are mostly looked after in out-of - school provision.

Nurseries look after and educate children aged 0-5. They are registered and inspected by the LA. There are different types of nurseries: private, local authority, community (non-profit), and workplace. 77% of day nurseries are run by private sector. Majority of public nurseries are provided by Local Education Authority (62%), private or independent schools (22%), and community or voluntary organisations (10%) (Blake et al., 2000, 2001). At least half the staff must be trained. Staffing levels are: one member of staff for every child between three to five years old, one for every four children aged two to three and one for every three children aged under two. Day nurseries primarily look after babies and children up to four years old (Callender, 2000). Most nurseries provide between 26 and 40 places. The expected price per child per week is between £80 and £180 and the average price for full-time care for a two-year old is £110.49 (Daycare Trust).

Registered day nurseries in the private and voluntary sector a.k.a. independent or registered day nurseries, offer day care for children aged 0-4 and are largely dependent on parental fees and more recently, the nursery education grants, which

have experienced a rapid growth. Independent/registered day nurseries are a primary source of employment for childcare workers or nursery nurses. On average, the heads of nurseries had thirteen years of experience and other staff 6 years. 22% of heads and 33% of other staff had no childcare qualifications. Gross hourly pay for childcare workers varies from less than £3 for playgroup workers to £17 for nursery teachers (Daycare Trust, 1997).

Blake et al. (2000, 2001) examine mostly nursery education and say that one is more likely to attend nursery education coming from higher social classes. In 1997, 19% of 3 year olds and 11% of 4 year olds attended childcare in the week before the interview (in 1999, these figures were 21% and 15%, respectively). Participation in different types of nursery education varies by the age of the child, for example, playgroups and preschools are most common for younger children, reception classes for older children and nursery classes for the mid age groups. The younger children are more likely to attend part-time. 52% of parents thought there were not enough places providing nursery education in the area (48% said not enough places in general, 36% said trouble finding place, 25% not enough choice in provision, 19% not enough state provision). Importantly, 52% of parents surveyed thought there were not enough information available to help them choose a place. 52% thought the education in local area was excellent or good (white parents were more likely to rate the care as good). Only 2% described it as not very or at all good. 28% of nursery school users paid education fees, and 53% paid for meals and refreshments. Parents were least likely to pay anything in reception classes in which 41% paid nothing, in nursery classes 29% paid nothing while in day nurseries only 8% paid nothing. Among those who had some or all education

fees paid for, the fees were paid for by LEA (69%) or DSS (10%). 25% of parents said that the costs restricted the amount of nursery education their child received (more common for low income families). The average distance to nursery school was 2.4 miles. 21% of parents reported that choice of nursery education was restricted by means of transport. The priorities when parents choose the provider include: 49% if local, 30% if easy to get to, 41% if good reputation, 30% if sibling has same provider.

A further option is early education and nursery classes at schools. They are part of primary or independent schools and the places are usually for three and four year olds. Some are private and some are provided by the state. The staffing levels for early education classes are 2 members of staff to 20 children with at least one adult being a qualified teacher and the other a qualified nursery assistant for nursery schools. The nursery class staffing levels are 2 adults to 26 children. Nursery schools and classes are open from 9 am to 3.30pm and are likely to close for school holidays, hence working parents need to find supplementary care. Nursery schools and reception classes for 4 year olds at primary schools are most likely to be free of charge and are also the most common type of care used.

APPENDIX TWO: FINNISH FAMILY POLICY AND CHILDCARE SYSTEM

The 450 municipalities are responsible for providing social and health care services including childcare in a country with a population of 5.1 million inhabitants or 1.4 million families, of which 635,000 have children present (about 18% of these are single parent families). The childcare services are funded with local taxes levied by the municipalities and with the subsidies allocated to them by the state. The customers using social and health care services also pay additional, although small, fees.

In 1948, child allowance system was introduced, however, childcare was mostly provided at home by mothers or nannies, or at private childcare centres. In the 1960's, as female employment started booming shortages in the childcare services appeared. Hence, in 1973, the government introduced the Children's Day Care Act, which placed responsibility for the pre-school childcare on the municipalities.

In 1990, parents were entitled to unconditional childcare for children under the age of three either at a childcare centre or by receiving child home care allowance. In 1996, the entitlement to municipal childcare was expanded to include the parents of all pre-school age children (less than seven). After the childcare voucher experiment, which ran from 31.5.1995 until 31.7.1997, the voucher was introduced nationally and parents had the option of receiving financial support for arranging private childcare for their children.

Public childcare services are funded by local taxes levied by the municipalities with the subsidies allocated by the state. The customers using social and health

care services also pay additional, although small, means-tested fees. VATT (1995) reports that in 1993 all governmental aid to families with children (including tax deductions) amounted to 5.6% of the GDP, of which 24% is spent on childcare and 12% on the home care allowance. Parents pay about 12% of the cost of public childcare; the fees are means-tested and range from 65 to 241 euros per child per year in 5 increments determined by the municipality. The municipality also decides the level of income below which childcare is provided free of charge. Family benefits in 1997 came to about 4.2 billion euros i.e. about 4% of GDP. Table A1 shows the distribution of family benefits in 1997.

Table A1: Distribution of family benefits in Finland (1997)

	%
Child allowance	33.1
Daycare	32.8
Parental allowances	10.8
Child home care allowance	8.1
Private childcare allowance	0.2
Housing allowance	5.0
Maintenance allowance	1.9
Home help	0.8
Institutional care for children and young people	3.1
Other	4.2

Maternity leave in Finland is 105 working days and an employee has the right to return to the same or equivalent position at the end of the maternity leave. At the end of the maternity leave either parent can take up paid parental leave for a maximum of 158 working days for first child and 60 days for each additional child. Paternity leave can be used during the maternity leave or parental leave for a maximum of 18 working days taken in a maximum of four periods. The paternity leave can be extended by 1-12 working days if the father uses the minimum of 12 days at the end of the parental leave. Home care allowance can be taken up at the end of the parental leave period and lasts until the child turns three years without

affecting the employment status at return to work. All these benefits depend on previous wages or are set for the previously unwaged.

In September 1997, the Ministry for Social and Health Services (1998) interviewed 1/3 of all municipality representatives. They summarise that 46% of all pre-school age children are in municipality provided childcare and of those about 80% are in full-time care and 64% are in nurseries while 36% are cared for by a childminder. However, there are large differences by the age of the child. In 1995, a quarter of 1-2 year olds were in childcare provided by the municipality and over 70% were taken care of at home using the home-care allowance (Takala, 2000). Heikkilä and Takala (1999) show statistics that only 2% of babies (less than one year olds) are in formal childcare arrangements.

In 1997, the private childcare allowance was adopted nationally. It amounts to 117.73 euros per month per child as a lump sum plus a means-tested component worth up to 134.55 euros per month. The allowance is paid to the private producer of the care. The producer of the private care cannot be a relative (in which case the family should use the home care allowance) and the receipt of the private care allowance requires a contract to exist between the family and the producer of care. The private care allowance is taxed through the producer of the care.

At the same time the home care allowance was worth 252.28 euros per month plus 84.09 euros per month for each child under three and 50.46 euros per month for any 3-6 year old sibling. On top of this lump sum fee, a means-tested component of maximum value of 168.19 euros per month is paid depending on the family's income. Hence the home care allowance is worth up to €250 more per

month than the childcare voucher. The municipality of residence in some cases pays an additional subsidy on top of these payments. The home care allowance can be used to hire a nanny to take care of the children at home. Furthermore, the home care allowance is taxable income.

Municipality provided public care cost a maximum of 200 euros per month for the first child and a maximum of 180 euros for the second child. Each additional child pays a fee that is proportional to the total cost of childcare provision. The public care is means-tested in the whole country.

APPENDIX THREE: DETAILS OF SELECTED CHILDCARE LITERATURE

Study (year) [country]	Data	Sample	Estimation procedure	Measure of childcare costs	Measure of labour supply	Impact of increase in childcare costs	Childcare price elasticity of employment	Childcare price elasticity of use of formal childcare	Wage elasticity of employment
Averett et al. (1997) [US]	1986 National Longitudinal Survey of Youth	Married mothers	MLE of dual-error term model for non-linear budget sets	Selectivity corrected predicted hourly price with appropriate tax credit deducted if employed and using care	Annual hours of work	Increased tax credits increase annual hours worked through effect on wage net of childcare costs	-0.78	n/a	n/a
Blau and Robins (1988) [US]	1980 Baseline Household Survey of Employment Opportunity Pilot Project	Married mothers	Multinomial logit	Average community cost from those who purchase childcare	Mother not employed vs. four combinations of mother employed/ childcare type/ employment status of other relative	Reduces likelihood of working and purchasing formal care	–0.38	-0.34	n/a
Blau and Robins (1989) [US]	1980 Baseline Household Survey of Employment Opportunity Pilot Project	Married mothers	Hazard estimates of transition probabilities out of various labour supply and fertility states	Selectivity corrected predicted costs by community	Employed vs. not employed	Reduces probability of entering employment ands increases probability of leaving employment	-0.77	n/a	0.55

Study (year) [country]	Data	Sample	Estimation procedure	Measure of childcare costs	Measure of labour supply	Impact of increase in childcare costs	Childcare price elasticity of employment	Childcare price elasticity of use of formal childcare	Wage elasticity of employment
Blau and Robins (1991) [US]	1982-1986 National Longitudinal Survey of Youth		Quasi-MLE of probits on employment, child status and formal childcare	Selectivity corrected predicted costs from employed mothers who purchase care	Employed vs. not employed	No effect on employment or the decision to use formal care	n/a	n/a	n/a
Choné et al. (2003) [France]	1997 Enquête Revenu Fiscaux	Married mothers	One-stage simulated maximum likelihood	Total childcare expenditure	Discrete-choice with eight states for hours and use of formal care	Reduces paid care utilisation but no effect for employment	-0.01	-0.29	0.80
Cleveland et al. (1996) [Canada]	1988 Canadian National Childcare Survey (a supplement to the Labour Market Activity Survey)	Married mothers	Bivariate probit on work and use of childcare decision	Selectivity corrected predicted costs from employed mothers who purchase care	Labour force participation	Reduces likelihood of working and purchasing formal care	-0.39	-1.06	0.81
Connelly (1989) [US]	Wave 5 of 1984 Panel of Survey of Income and Program Participation	Single and married women	Tobit	Selectivity corrected predicted costs from employed mothers who purchase care	Hours worked	Reduces hours for single women but no effect on married women	-0.49	n/a	n/a

Study (year) [country]	Data	Sample	Estimation procedure	Measure of childcare costs	Measure of labour supply	Impact of increase in childcare costs	Childcare price elasticity of employment	Childcare price elasticity of use of formal childcare	Wage elasticity of employment
Connelly (1992) [US]	Wave 5 of 1984 Panel of Survey of Income and Program Participation	Married mothers	Probit	Selectivity corrected predicted costs from employed mothers who purchase care	Labour force participation	Reduces the probability of participation	-0.20	n/a	n/a
Del Boca et al. (2003) [Italy]	Bank of Italy's SHIW and Multiscopo for 1998	Married mothers	Bivariate probit for work and childcare use	Regional public and private costs	Labour force participation	No significant effect on work or childcare use	n/a	n/a	n/a
Duncan et al. (2001) [UK]	1994/5-1998/9 Family Resources Survey	Married mothers	Probit for use of childcare	Quality adjusted predicted costs from employed mothers who purchase care	n/a	Reduces the probability of purchasing formal care	n/a	-0.26 to -0.46	n/a
Ermisch and Wright (1991) [UK]	1973-82 GHS	Working mothers					n/a	n/a	1.7
Fong and Lokshin (2000) [Romania]	Romanian Child Care and Employment Survey (1999)	Married and single mothers	Semiparametric Full Information Maximum Likelihood	Quality-adjusted location-specific price per hour	Discrete choice between six states for work and childcare use	Reduces the probability of purchasing formal care	-0.17	-0.41	n/a

Study (year) [country]	Data	Sample	Estimation procedure	Measure of childcare costs	Measure of labour supply	Impact of increase in childcare costs	Childcare price elasticity of employment	Childcare price elasticity of use of formal childcare	Wage elasticity of employment
Gustafsson and Stafford (1992) [Sweden]	1984 Swedish Household Survey		Logit	Average cost per commune per space, adjusted for subsidies	Work and use childcare on a full-time basis	Reduction in working and using childcare if public childcare is not rationed	n/a	n/a	n/a
Heckman (1974) [US]	1966 National Longitudinal Survey	Married mothers aged 30-44	MLE of marginal rate of substitution (MRS) between income and leisure	Proxies such as number of older children or relatives in household, spouse's hours of work, and length of residence	Indirect; MRS between income and leisure	Reduces participation probability and hours because of the increase in MRS between income and leisure	n/a	n/a	n/a
Hotz and Kilburn (1991) [US]	1986 National Longitudinal Survey of High School Class of 1972		Bivariate probit on employment and childcare choice decision	Selectivity corrected estimates of cost from households purchasing care	Employed vs. not employed	No significant effect on employment decision	n/a	n/a	n/a
Jenkins and Symons (2001) [UK]	1989 Lone Parent Survey	Single mothers	Probit	Selectivity corrected predicted costs from employed mothers who purchase care	Employed vs. not employed	Reduces the probability of participation	-0.09	n/a	0.25

Study (year) [country]	Data	Sample	Estimation procedure	Measure of childcare costs	Measure of labour supply	Impact of increase in childcare costs	Childcare price elasticity of employment	Childcare price elasticity of use of formal childcare	Wage elasticity of employment
Kimmel (1995) [US]	1987 Survey of Income and Program Participation	Single mothers	Probit	Selectivity corrected predicted costs from employed mothers who purchase care	Employed vs. not employed	Reduces the probability of participation	-0.35	n/a	2.0
Kimmel (1998) [US]	1987 Survey of Income and Program Participation	Married and single mothers	Probit	Selectivity corrected predicted costs from employed mothers who purchase care	Employed vs. not employed	Reduces the probability of participation	-0.92; -0.22[a]	n/a	3.25; 5.28[a]
Leibowitz et al. (1992) [US]	1986 National Longitudinal Survey of Youth	All mothers aged 21-28	Probit	Indirect measures such as presence of grandmother, spouse, or tax credits	Employment status at 3 and 24 months after childbirth	Mixed	n/a	n/a	n/a
Michalopoulos et al (1992) [US]	Wave 5 of 1984 Panel of Survey of Income and Program Participation	Married and single mothers	Non-linear least squares for estimation of Stone-Geary utility function	Indirect measures through tax credits	Hours worked	Reduced childcare tax credits reduce hours of work for currently employed mothers	n/a	n/a	0.04; -0.003[a]

Study (year) [country]	Data	Sample	Estimation procedure	Measure of childcare costs	Measure of labour supply	Impact of increase in childcare costs	Childcare price elasticity of employment	Childcare price elasticity of use of formal childcare	Wage elasticity of employment
Powell (1997) [Canada]	1988 Canadian National Childcare Survey (a supplement to the Labour Market Activity Survey)	Married mothers	Probit and OLS	Selectivity corrected predicted costs from employed mothers who purchase care	Employed vs. not employed, hours worked	Reduces the probability of working as well as the hours of work	-0.38	n/a	0.85
Powell (1998) [Canada]	1988 Canadian National Childcare Survey (a supplement to the Labour Market Activity Survey)	Married mothers	Ordered probit	Selectivity corrected predicted costs from employed mothers who purchase care	Mother employed full-time, part-time, or not employed	Reduces probability of both full-time and part-time employment	-0.21 to –0.71[b]	n/a	0.13 to 0.76[b]

Study (year) [country]	Data	Sample	Estimation procedure	Measure of childcare costs	Measure of labour supply	Impact of increase in childcare costs	Childcare price elasticity of employment	Childcare price elasticity of use of formal childcare	Wage elasticity of employment
Powell (2002) [Canada]	1988 Canadian National Childcare Survey (a supplement to the Labour Market Activity Survey)	Married mothers	Mixed logit choice model and universal logit choice model	Selectivity corrected predicted costs by mode of care	Mother not working, working (centre care), working (sitter care), working (relative care), working (husband care)	Reduces the probability of working and using each respective mode of care	n/a	-1.48 (-3.71) [-0.36][c]	-0.76[d]
Ribar (1992) [US]	Wave 5 of 1984 panel of Survey of Income and Program Participation	Married mothers	Simultaneous MLE probit of labour force participation and tobits on paid and unpaid childcare	Selectivity corrected estimates of cost from households purchasing care	Employed vs. not employed	Reduces probability of employment	-0.74	-1.86	0.68
Ribar (1995) [US]	Wave 5 of 1984 panel of Survey of Income and Program Participation	Married mothers	FIML estimation of discrete choice model with five alternatives	Selectivity-corrected estimates of pre-tax part-time and full-time childcare costs	Mother employed full-time, part-time, or not employed	Reduces probability of employment	-0.02 to –0.09[e]	-0.22 to –0.61[e]	-0.09 to 0.53[e]
Shimizutani and Noguchi (2004) [Japan]	n/a	n/a	n/a	n/a	n/a	n/a	-0.20	n/a	n/a

Study (year) [country]	Data	Sample	Estimation procedure	Measure of childcare costs	Measure of labour supply	Impact of increase in childcare costs	Childcare price elasticity of employment	Childcare price elasticity of use of formal childcare	Wage elasticity of employment
Wrohlich (2004) [Germany]	German Socio-Economic Panel 2002	Married or cohabiting mothers	Structural labour supply model with discrete hours	Selectivity-corrected hourly costs	Fifteen hours and childcare use categories	Small reduction in labour supply	-0.02 –0.03	n/a	0.12 to 0.13

Notes: [a] First figure for married mothers, second figure for single mothers.
[b] Lower figure is for part-time work, while the upper figure is for full-time work.
[c] Own-price elasticities for: work/centre, (work/sitter), and [work/relative] combinations.
[d] The wage elasticity of not working.
[e] Lower figures are based on a sample of pre-school mothers; the upper figures come from a sample of mothers with offspring under the age of 15.
n/a not available
Elasticities calculated at means

APPENDIX FOUR: FAMILY RESOURCES SURVEY

The empirical analysis in Chapter 2 and Chapter 3 is conducted using five waves of the Family Resources Survey (FRS). This data covers the fiscal years 1993/4-1997/8. The FRS is an annual cross-sectional survey of around 26,000 British households each year, which is launched by the Department of Social Security for policy monitoring and evaluation as well as benefit expenditure forecasting. The benefits of using the FRS include large sample sizes and inclusion of detailed questions relating to the labour market activity and childcare use and other characteristics of the family as well as benefits and childcare take-up and expenditure.

The childcare section of the FRS provides information for each dependant child on who looks after the child with multiple responses permitted with following options: close relative (partner and other children etc.), other relative, friend/neighbour, childminder, nursery/playgroup, crèche, other (nannies, au pairs, after-school and school-holiday clubs). For each child and per type of care there are questions on the hours of childcare used separately for the holiday and term time, the payment for childcare if any, and the amount spent each week during term and holiday period. The information on parental employment is collected at the time of the survey.

In my analysis the FRS is augmented with a local authority (LA) level data on the availability of different types of childcare as recorded by the annual Department of Health publications "Children's Day Care Facilities". Figures are collected on

day nurseries, childminders, playgroups, out of school clubs and family centres as well as playgroup sessions on a voluntary basis (first year for playgroups). The statistics in these publications are compiled from surveys completed by each LA in England on 31 March of each year. All LA's are required to keep records of day care services that have to be registered and inspected under the Children Act (1989). The majority of LA's submitted the data for all years.

Information is collected for each of the 109 LA's on the following that are relevant for this analysis (the data is also collected for school age children but this information is not used in my analysis): number of day nurseries and places for children aged under five, number of playgroups and places for children aged three to five, number of childminders and places for children aged under five. All of these statistics are calculated as places provided per 10,000 of the relevant age population for each childcare setting. The Department of Health statistics are merged into the FRS at the local authority level[98]. FRS does not provide a big enough sample size for smaller regions that could be appropriate for the analysis.

The Department of Health statistics on day care facilities do not cover unregulated and informal forms of childcare such as nannies, or care by relatives or by unregistered childminders. However, Moss et al. (1998) regard these statistics as the most comprehensive source of national data on the supply of childcare regardless. Furthermore, Childcare Information Services collects data on childcare services and its cost in particular (only approximately 40 LA's provide this

[98] There is a problem with the reorganization of LA's into unitary authorities (see Paull and Taylor 2002 p.15).

information). Of the continuous household surveys only General Household Survey (GHS) in 1991 and FRS have included questions on childcare. These surveys include no information on parental preferences for the mode of childcare or on the unmet need for childcare.

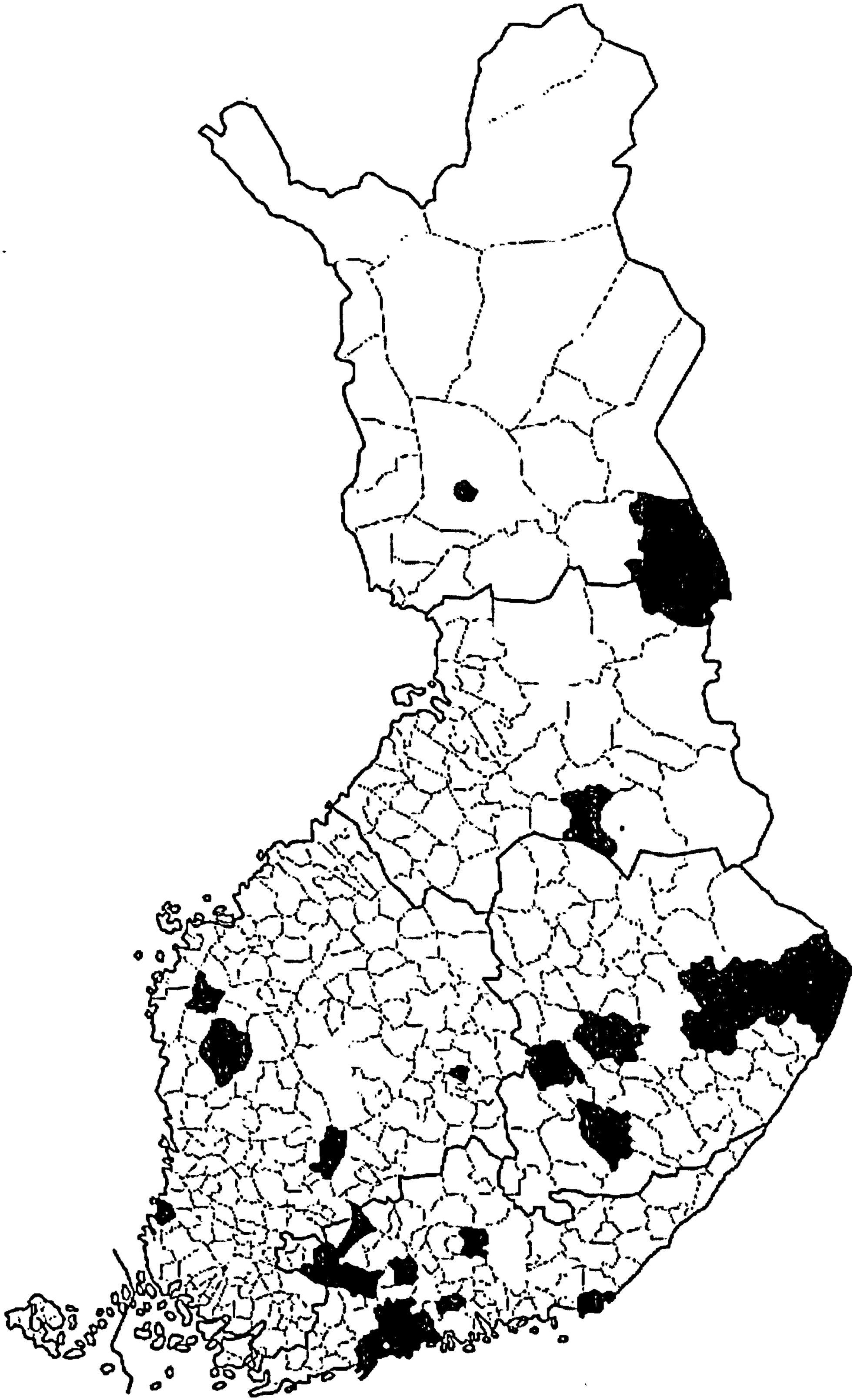
A possible drawback of FRS is that not all households with children are routed to answer the questions about childcare. Only women who work or have a working partner are asked the questions of whether they use childcare, which makes the analysis potentially non-representative of the non-working families.

APPENDIX FIVE: VOUCHER EXPERIMENT (TREATED)

Municipalities participating in the voucher experiment include: Askola, Espoo, Hattula, Hausjärvi, Helsinki, Hyvinkää, Ilomantsi, Joensuu (omitted), Jurva, Juva, Jyväskylä, Kajaani (omitted), Karkkila, Kauhajoki, Kerava (omitted), Kirkkonummi (omitted), Kontiolahti, Kuusamo, Leppävirta, Liperi, Loppi, Mäntsälä, Mikkeli (omitted), Nurmijärvi, Polvijärvi, Pyhäselkä, Rauma, Rovaniemi, Sipoo, Tampere, Tuusula, Vantaa (omitted), Virolahti.

Some of the municipalities are omitted from the analysis since their voucher experiment differed from the majority. For example, Mikkeli, Kirkkonummi, and Joensuu had a voucher for childcare in place already in 1994, however, their voucher experiment was not perfect since not all childcare places were open for competition.

Geographically the municipalities are distributed as indicated by the darkened areas in the following map.



APPENDIX SIX: INCOME DISTRIBUTION SURVEY

The data used in Chapter 4 comes from the Income Distribution Survey[99] (referred to as IDS) from 1994 until 1997. The IDS is a rotating panel survey interviewing 10,000 households per year. Each household is interviewed for two consecutive years. The interview data is linked with data from administrative registers, for example, on income and subsidies. All the data is provided on an annual basis, for example, employment participation is reported as months per year.

The information on the municipality of residence is not released in the IDS due to confidentiality reasons. Instead Statistics Finland has, on request, created dummies to identify the experimental regions including any variation in the type of voucher.

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[99] Tulonjakotilasto in Finnish.